M.Sc., CHEMISTRY

SYLLABUS

Programme Code: 2PSCHE

2026-2027

SENGAMALA THAYAAR EDUCATIONAL TRUST

WOMEN'S COLLEGE (AUTONOMOUS)

(Affiliated to Bharathidasan University, Tiruchirappalli)
(Accredited by NAAC)
SUNDARAKKOTTAI, MANNARGUDI–614016.
TAMILNADU, INDIA.

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)

(Affiliated to Bharathidasan University, Tiruchirappalli)

Accredited by NAAC-An ISO 9001:2015 Certified Institution

SUNDARAKKOTTAI, MANNARGUDI–614016.

TAMILNADU, INDIA.

M.Sc., CHEMISTRY

CHOICE BASED CREDIT SYSTEM - LEARNINIG OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(For the candidates admitted in the academic year 2026-2027)

CHOICE BASED CREDIT SYSTEM

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our College has moved to CBCS and implemented the grading system.

OUTCOME-BASED EDUCATION (OBE)
LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The expected learning outcomes are used as reference points that would help to formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery and review of academic programmes. They provide general guidance for articulating the essential learnings associated with programmes of study and courses with in a programme, maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility and provide higher education institutions an important point of reference for designing teaching- learning strategies, assessing student learning levels, and periodic review of programmes and academic standards.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Some important terminologies repeatedly used in LOCF.

Core Courses (CC): A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Centric Elective Courses (DCE): Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

Generic Elective Courses: An elective course chosen generally from an **unrelated discipline/subject,** with an intention to seek exposure is called a Generic Elective. Generic Elective courses are designed for the students of other disciplines. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

Non Major Elective (NMEC): A student shall choose at least two Non-major Elective Courses (NMEC) from outside his/her department.

Skill Enhancement Courses (SECs): These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge**.**

Field Study/Industrial Visit/Case Study: It has to be completed during the fifth semester of the degree programme. Credit for this course will be entered in the fifth semester's marks statement.

Internship: Students must complete internship during summer holidays after the fourth semester. They have to submit a report of internship training with the necessary documents and have to appear for a viva-voce examination during fifth semester. Credit for internship will be entered in the fifth semester's mark statement.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTELetc.

EXAMINATION

Continuous Internal Assessment (CIA):

UG - Distribution of CIA Marks

Passing Minimum: 40 %

Assisgnment-3	=	30%
Test-2	=	50%
Seminar	=	10%
Attendance	=	10%

Question Paper Pattern

Section A1 (10x1=10 marks)
One word question/ Fill in/ True or False/ Multiple Choice Questions
Two Questions from Each unit
Section A 2 (5x2=10 marks)
Short Answers / Match the following
One question from Each unit
Total Marks – 20
Section B: (5x4=20 marks)
Paragraph Answers
Either/ or type, One Question from each unit
Section C: (10x3=30)
Essay Type Answers
Answer 3 out of 5 Questions
One Question from each unit
Section A1 & A2: K1 Level
Section B: K2, K3 and K4 Level
Section C: K5 and K6 Level

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/ Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analyzing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

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WEIGHTAGE of K – LEVELS IN QUESTION PAPER

(Cognitive Level) K- LEVELS	Lower Order Thinking			Higher Order Thinking			Total
	K1	K2	K3	K4	K5	K6	
END SEMESTER EXAMINATIONS (ESE)	20	20			30		**70**
Continuous Internal Assessment (CIA)	20	20			30		**70**

QUESTION PATTERN FOR END SEMESTER EXAMINATION/ Continuous Internal Assessment

SECTION		MARKS
SECTION – A1 (No choice ,One Mark) **TWO** questions from each unit **SECTION –A2** (No choice ,Two Mark) **ONE** question from each unit	(10x1 =10) (5x2 =10)	20
SECTION - B (Either/ or type, 4-Marks) **ONE** questions from each unit	(5x4 =20)	20
SECTION - C (3 out of 5) (10 Marks) **ONE** question from each unit	(3x10 =30)	30
	Total	**70**

BLUE PRINT OF QUESTION PAPER FOR END SEMESTER EXAMINATION							
DURATION: 3. 00 Hours.							**Max Mark : 70**
K- LEVELS **SECTION**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION –A1 (1 Mark, No choice) (10x1 =10)	10						10
SECTION –A2 (2-Marks, No choice) (5x2=10)	10						10
SECTION –B (4-Marks) (Either/or type) (5x4=20)		4	8	8			20
SECTION -C (10 Marks) (3 out of 5) (3x10=30) Courses having only **K5, K6** levels, K5 level- 3 Questions, K6 level- 2 Questions **(One K6 level question is compulsory)**					20	10	30
Total	**20**	**04**	**08**	**08**	**20**	**10**	**70**

EVALUATION

GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

Grade Point Average (GPA) will be calculated from the first semester onwards for all semester. From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) , respectively. These two are calculated by the following formulae:

$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{I=1}^{n} C_i}$	$WAM(\text{Weighted Average Marks}) = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{I=1}^{n} C_i}$
Where, C_i is the Credit earned for the Course$i$ G_i is the Grade Point obtained by the student for the Course$i$ M_i is the marks obtained for the course$i$ and n is the number of Courses **Passed** in that semester.	

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

CLASSIFICATION OF FINAL RESULTS:

i. The classification of final results shall be based on the CGPA, as indicated in Table-2.

ii. For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99 and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii. Absence from an examination shall not be taken an attempt.

Table- 1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	**10**	**O**
80 and above and below 90	**9**	**A+**
70 and above and below 80	**8**	**A**
60 and above and below 70	**7**	**B+**
50 and above and below 60	**6**	**B**
Below50	**NA**	**RA**

NA- Not Applicable, RA- Reappearance

The candidates performance in every current semester is indicated by **Semester Grade Point Average (SGPA)** and from the second semester onwards, the continuous performance including previous semester/s is indicated by **Cumulative Grade Point Average (CGPA)**

Table-2: Final Result

CGPA	Corresponding Grade	Classification of Final Result
9.00 and above	**O**	**Outstanding**
8.00 to 8.99	A+	**Excellent**
7.00 to 7.99	**A**	**Very Good**
6.00 to 6.99	**B+**	**Good**
5.00 to 5.99	**B**	**Above Average**

***** The candidates who have passed in the first appearance and within the prescribed duration of the PG Programme are eligible. If the candidate's Grade is O/A+ with more than one attempt, the performance is fixed as "Very Good"

Vision

To Empower the women students by providing excellent theoretical, practical and research skills in Chemistry to meet the global needs.

Mission

- Providing quality education in the principles, theory and practice of Chemistry.
- Making the students to cope up with the requirements of industry and service sectors.
- Excelling in teaching, research, knowledge transfer and to serve the social, cultural and economic needs of the nation.

PROGRAMME OUTCOMES FOR M.Sc.,DEGREE PROGRAMMES

PO.No	Programme Outcomes (*Upon completion of the M.Sc.,Degree Programme, the Post graduate will be able to)*
PO-1	**Disciplinary Knowledge**: demonstrate in-depth knowledge and understanding of theories, policies, and practices in one or more disciplines that form a part of a Post Graduate program of study in Master of Science.
PO-2	**Critical Thinking and Problem Solving**: apply analytic thought to a body of knowledge, analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence, identify relevant assumptions or implications, formulate coherent arguments, critically evaluate practices, policies and theories by following scientific approach to knowledge development: solve problems and extrapolate the same to real life situation
PO-3	**Information/digital literacy and Communication Skills:** use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data: communicate thoughts and ideas analytically and effectively in writing and orally using appropriate media, and present complex information in a clear and concise manner to different groups.
PO-4	**Research-related skills:** conduct independent inquiry in a chosen scientific discipline, demonstrate sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesizing and articulating; recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; plan, execute and report the results of an experiment or investigation.
PO-5	**Scientific reasoning and Reflective Thinking:** analyse, interpret and draw conclusions from quantitative/qualitative data and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; critically and sensibly evaluate life experiences, with self awareness and reflexivity of both self and society.
PO-6	**Multidisciplinary Approach, Innovation and Entrepreneurship:** propose novel ideas of interdisciplinary approach in providing better solutions and new ideas for the sustainable developments; identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society.
PO-7	**Moral and ethical awareness/reasoning:** embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work, demonstrate the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.
PO-8	**Self directed Learning:** work independently, identify appropriate resources required for a project, and manage a project till completion.
PO-9	**Lifelong Learning:** engage in continuous learning for professional growth and development, acquire knowledge and skills, adapt to changing environment and to changing trades and demands of work place through knowledge/skill development/reskilling.
PO-10	**Multicultural Competence, Social Interaction and Effective Citizenship:** understand the values and beliefs of multiple cultures, global perspectives, engage and interact respectfully with diverse groups and elicit views of others, mediate disagreements and help reach conclusions in group settings, and demonstrate empathetic social concern and equity centred national development

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO. No.	Program Specific Outcomes **(M.Sc., Chemistry)**
PSO1	**Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions
PSO2	**Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations
PSO3	**Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.
PSO4	**Contribution to Business World:** To produce employable, ethical and innovative professionals to sustain in the dynamic business world.
PSO5	**Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit

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M.Sc., CHEMISTRY
CHOICE BASED CREDIT SYSTEM -
LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)
(Applicable to the candidates admitted from the academic year 2026 - 2027 onwards)

ELIGIBILITY: Candidates who have passed a Bachelor's Degree in Chemistry

Sem.	Course	Course Code	Course Title	Ins. Hrs.	Credit	Exam Hrs.	Marks		Total
							Int.	Ext.	
I	Core Course - I (CC-I)	P26CH101	Inorganic Chemistry-I	6	4	3	30	70	100
	Core Course - II (CC-II)	P26CH102	Organic Chemistry-I	6	4	3	30	70	100
	Core Practical -I (CP-1)	P26CH103P	Inorganic Chemistry Practical-I	6	4	6	40	60	100
	Discipline Centric Elective Course -I (DCEC-I)	P26CHDE11A P26CHDE11B P26CHDE11C	Coordination Chemistry Kinetics, Electrochemistry and Thermodynamics Biophysical Chemistry	5	4	3	30	70	100
	Generic Elective Course -I (GEC-I)	P26CHGE11A P26CHGE11B P26CHGE11C	Food Chemistry Forensic Chemistry Catalysis	5	3	3	30	70	100
	Skill Enhancement Course -I (SEC-I)	P26SECH11	Chemistry of Consumer Products	2	2	3	30	70	100
	Value Added Course -I (VAC-I)*	P26CHVA11	Advanced AI Applications in Chemistry and Molecular Sciences	-	2*		30	70	100*
	Total			**30**	**21**	**-**	**-**	**-**	**600**
II	Core Course -III (CC-III)	P26CH204	Organic Chemistry-II	6	4	3	30	70	100
	Core Course - IV (CC-IV)	P26CH205	Physical Chemistry-I	6	4	3	30	70	100
	Core Practical - II (CP-II)	P26CH206P	Organic Chemistry Practical	6	4	6	40	60	100
	Discipline Centric Elective Course -II (DCEC-II)	P26CHDE22A P26CHDE22B P26CHDE22C	Molecular Spectroscopy Bioinorganic and Organometallic Chemistry Inorganic Photochemistry	4	4	3	30	70	100
	Generic Elective Course-II (GEC-II)	P26CHGE22A P26CHGE22B P26CHGE22C	Green Chemistry Supramolecular Chemistry Solid State Chemistry	4	3	3	30	70	100
	Skill Enhancement Course -II (SEC-II)	P26SECH22	Sustainable Water Resources Management.	2	2	3	30	70	100
	Non-Major Elective			2	2	3	30	70	100

	Course -I (NMEC-I)								
	Total			**30**	**23**	**-**	**-**	**-**	**700**
Summer Internship / Industrial Activity during the Summer Vacation after 1st Year									

III	Core Course -V (CC-V)		Inorganic Chemistry-II	6	4	3	30	70	100
	Core Course –VI (CC-VI)		Spectral Techniques in Inorganic Compounds	6	4	3	30	70	100
	Core Practical –III (CP-III)		Inorganic Chemistry Practical-II	6	4	6	40	60	100
	Discipline Centric Elective Course - III (DCEC-III)		Analytical Chemistry / Organic Photochemistry, Pericyclic Reactions and Spectroscopy / Bioorganic Chemistry	5	4	3	30	70	100
	Generic Elective Course –III (GEC-III)		Research methodology. / Materials Chemistry / Agricultural Chemistry	5	3	3	30	70	100
	Non-Major Elective Course -II (NMEC- II)			2	2	3	30	70	100
	Internship / Industrial Activity @				2		20	80	100
	Value Added Course – II (VAC-II)*		Advances in Data Science using python and R Programming	-	2*	3	30	70	100*
	Total			**30**	**23**	**-**	**-**	**-**	**700**
IV	Core Course –VII (CC –VII)		Physical Chemistry-II	6	4	3	30	70	100
	Core Course - VIII (CC -VIII)		Chemistry of Nanomaterials	6	4	3	30	70	100
	Core Practical –IV (CP -IV)		Physical Chemistry Practical	6	4	6	40	60	100
	Discipline Centric Elective Course -IV (DCEC -IV)		Pharmaceutical Chemistry / Chemistry of Biomolecules / Electrochemistry	4	4	3	30	70	100
	Entrepreneurship / Industry Based Course @		Industrial Chemistry	3	3	3	30	70	100
	Project Work @			5	5	-	20	80	100
	Extra Credit Course other than VAC**		MOOC-NPTEL / SWAYAM**		2**				
	Total			**30**	**24**	**-**	**-**	**-**	**600**
	Grand Total				**91**				**2600**

LIST OF DISCIPLINE CENTRIC ELECTIVE COURSE

S. No.	Semester	Discipline Centric Elective Course (DCEC)
Discipline Centric Elective Course - I (DCEC – I)		
1.	I	Coordination Chemistry
2.		Kinetics, Electrochemistry and Thermodynamics
3.		Biophysical Chemistry
Discipline Centric Elective Course - II (DCEC - II)		
1.	II	Molecular Spectroscopy
2.		Bioinorganic and Organometallic Chemistry
3.		Inorganic Photochemistry
Discipline Centric Elective Course - III (DCEC - III)		
1.	III	Analytical Chemistry
2.		Organic Photochemistry, Pericyclic Reactions and Spectroscopy
3.		Bioorganic Chemistry
Discipline Centric Elective Course - IV (DCEC - IV)		
1.	IV	Pharmaceutical Chemistry
2.		Chemistry of Biomolecules
3.		Electrochemistry

S. No.	Semester	Generic Elective Course (GEC)
Generic Elective Course - I (GEC – I)		
1.	I	Food Chemistry
2.		Forensic Chemistry
3.		Catalysis
Generic Elective Course - II (GEC – II)		
1.	II	Green Chemistry
2.		Supramolecular Chemistry
3.		Solid State Chemistry
Generic Elective Course - III (GEC – III)		
1.	III	Research methodology.
2.		Materials Chemistry
3.		Agricultural Chemistry

(NME) OFFERED BY THE DEPARTMENT

S .No	Semester	Course Code	Title of the Paper
1	II	P26NMECH21	Chemistry of Pollution, Food and Cosmetics
2	III		Chemistry in Day-to-day Life

SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES: SCIENCE

Sl. No.	Types of the Course	No. of Courses	Credits for each Course	Total Credits	Marks
1.	Core Course (CC)	8	4	32	800
2.	Core Practical (CP)	4	4	16	400
3.	Discipline Centric Elective Course (DCEC)	4	4	16	400
4.	Generic Elective Course (GEC)	3	3	9	300
5.	Skill Enhancement Course (SEC)	2	2	4	200
6.	Non-Major Elective Courses (NMEC)	2	2	4	200
7.	Internship / Industrial Activity @	1	2	2	100
8.	Entrepreneurship / Industry Based Course	1	3	3	100
9.	Project work@	1	5	5	100
Total		**26**	**-**	**91**	**2600**
Value Added Courses *		2*	2	4*	200

*	**The value-added courses credit will not be included in the total CGPA. These courses are extra-credit courses. Instruction hours for these courses are 30 hours**
@	Summer Internship will be carried out during the summer vacation after the First year. Viva Voce will be conducted by the college and Marks shall be sent to the University and the same will be included in the 3rd semester Mark Statement. **Summer Internship / Industrial Activity and Project Scheme of Evaluation:** **Scheme of valuation**.

Description	Marks
Report	80
Viva	20
Total	100

SEMESTER I

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(For the Candidates admitted in the academic year 2026 – 2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: I - CC I : INORGANIC CHEMISTRY – I

Ins. Hrs. /Week: 6 **Course Credit: 4** **Course code:** P26CH101

COURSE OBJECTIVES

- To explain the basic concepts of main group elements.
- To learn homocyclic inorganic systems.
- To study Instrumental Techniques.
- To study the concepts of photochemistry and its applications.
- To Understand Ionic Bonding and Crystal Structure.

UNIT – I : MAIN GROUP CHEMISTRY **(18 HOURS)**

Chemistry of boron – borane, higher boranes, carboranes, borazines and boron nitrides; chemistry of silicon – silanes, higher silanes, multiple bonded systems, disilanes and silicon nitrides. P–N compounds, cyclophosphazanes and cyclophosphazenes; S–N cations and anions; S–P compounds; molecular sulphides such as P_4S_3, P_4S_7, P_4S_9 and P_4S_{10}. Industrial applications of boranes and silanes.

UNIT – II : HOMOCYCLIC INORGANIC SYSTEMS

(17HOURS)

Oxo carbon anion. Ionic model; lattice energy; Born–Landé equation; Kapustinskii equation; tarnish reaction decomposition; solid–solid reactions and photographic processes; factors affecting reaction rate. Simple methods (potentiometric, pH-metric and photometric methods) for determining formation constants.

UNIT – III : INSTRUMENTAL TECHNIQUES IN NUCLEAR CHEMISTRY

(19 HOURS)

Nucleus – structure of the nucleus, radioactive equilibrium, orbital electron capture, nuclear isomerism and internal conversion. Nuclear cross section, Q-value of nuclear reactions, Coulombic barrier, threshold energy and excitation function. Different types of nuclear reactions – fragmentation, nuclear fission and nuclear fusion. Proportional counter, Geiger–Müller counter and scintillation counter. Applications in carbon dating, agriculture, medicine and industry.

UNIT – IV : PRINCIPLES OF WET CHEMICAL ANALYSIS AND ACID–BASE THEORY
(19HOURS)

Qualitative Analysis: Solubility product; principle of elimination of interfering anions; common ion effect; complexation reactions including spot tests in qualitative analysis; reactions involved in the separation and identification of cations and anions; semi-micro techniques.

Acids and Bases: Arrhenius and Lewis theories of acids and bases; Usanovich generalized definition; relative strengths of acids and bases; dissociation constants of acids and bases; levelling effect of water; hard and soft acids and bases (HSAB).

UNIT – V : PHOTOCHEMISTRY (17 HOURS)

Adamson's rules; photoactive excited states; V–C model; photophysics and photochemistry of ruthenium polypyridine complexes; emission and redox properties. Photochemistry of organometallic compounds, metal carbonyl compounds and compounds with metal–metal bonding. Reinecke's salt chemical actinometer.

UNIT – VI : Current Contours (For Continuous Internal Assessment Only – Self Study)

Ionic bonding: Formation of ionic bonds, characteristics of ionic compounds, factors influencing ionic bond formation, lattice energy and its significance, Born–Haber cycle and its applications.

Crystal structure: Space lattice, unit cell, crystal systems, Bravais lattices, packing in crystals, coordination number, radius ratio rules and limitations.

Structures of ionic solids: Sodium chloride (NaCl), cesium chloride (CsCl), zinc blende (ZnS), wurtzite and fluorite structures.

Total Lecture Hours: 90

COURSE OUTCOMES

Students are able to

1. Learn the fundamentals of the chemistry of the main group elements, and important Realworld applications of many of these species
2. Determine stability constant of particular complex through pH metry,polagraphicmethods Etc.,
3. Understand the structure of nucleus, types of nuclear reactions fission and counters usedin the determination.
4. Learn the ionic bonding and crystal structure.
5. Understand the the photochemistry of organo metallic compounds.

TEXT BOOK(S)

1. Cotton, F. A., Wilkinson, G., Murillo, C. A., & Bochmann, M. (2026). Advanced Inorganic Chemistry. Wiley India Pvt. Ltd.
2. Huheey, J. E. (2006). Inorganic Chemistry (4th ed.). Harper and Row Publishers, Singapore.
3. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (2003). Inorganic Chemistry: Principles of Structure and Reactivity. Addison-Wesley, New York.
4. Lee, J. D. (1998). Concise Inorganic Chemistry (6th ed.). ELBS, London.
5. Sharma, R. K. (2007). Inorganic Reaction Mechanism. Discovery Publishing House, New Delhi.

REFERENCE BOOK(S)

1. Adamson, A. W. (1975). Concepts of Inorganic Photochemistry. John Wiley & Sons, New York.
2. Adamson, A. W., & Fleischauer, P. D. (1984). Concepts of Inorganic Photochemistry. R. E. Krieger Publications, Florida.
3. Chatwal, G., & Anand, S. (2018). Instrumental Methods of Chemical Analysis (Paperback Edition).
4. Cotton, F. A., Wilkinson, G., Murillo, C. A., & Bochmann, M. (1999). Advanced Inorganic Chemistry (6th ed.). Wiley-Interscience Publications, John Wiley & Sons, USA.
5. Day, M. C., Selbin, J., & Sisler, H. H. (2026). Theoretical Inorganic Chemistry. Literary Licensing (LLC), Montana.

E-RESOURCES

1. http://academic.macewan.ca/gelminil/231_1.pdf
2. www.osti.gov/biblio/6090744
3. http://www.tcm.phy.cam.ac.uk/~cjp20/old/lectures/topic1.pdf
4. https://en.wikipedia.org/wiki/Aromaticity
5. www.springer.com

MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	2	1	1	2	1	2	3	1	1	2	2
CO2	3	3	2	2	2	1	1	2	1	2	3	2	2	2	2
CO3	3	2	3	3	2	1	2	2	1	2	2	3	2	3	2
CO4	3	3	3	2	2	1	1	2	1	2	3	3	3	2	2
CO5	3	3	2	3	3	1	1	2	1	2	2	2	2	3	3
CO6	3	2	2	1	2	1	1	2	1	1	3	1	1	2	2

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

SUNDARAKKOTTAI, MANNARGUDI- 614016

(For the Candidates admitted in the academic year 2026-2027)

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY

Semester: I - CC-II: ORGANIC CHEMISTRY - I

Ins. Hrs. /Week: 6 **Course Credit: 4** **Course Code: P26CH102**

COURSE OBJECTIVES:

- To learn the nomenclature of organic compounds.
- To understand the stereochemistry of organic compounds.
- To understand the basic concepts of aromaticity.
- To know the oxidation and reduction reagents used in organic synthesis.
- To gain knowledge of geometrical isomerism and its significance in organic chemistry.

UNIT– I NOMENCLATURE OF ORGANIC COMPOUNDS, REACTIVE INTERMEDIATESAND ELECTRONIC EFFECTS: (15 HOURS)

Nomenclature of heterocyclics having not more than two hetero atoms such as oxygen, nitrogen and sulphur - Nomenclature of heterocyclic compounds of fused ring system - Nomenclature of alicyclic, bicyclic and tricyclic compounds.

Reactive Intermediates: Classical and non-classical carbocations, carbanions-free radicals, carbenes, nitrenes, arynes and singlet oxygen- general methods of generation, detection, geometry, stability and reactivity of these intermediates.

Electronic Effects: Inductive effect - resonance effect– hyper conjugation (Baker-Nathan effect) hydrogen bonding (inter and intramolecular) and steric effects.

UNIT–II METHODS OF DETERMINING REACTION MECHANISMS AND CORRELATION ANALYSIS (15 HOURS)

Kinetics and non-kinetic methods of determination of reaction mechanisms Thermodynamic and kinetic aspects of organic reactions ,energy profile diagrams - spectroscopic studies, isotopic effects - intermediate versus transition states - product analysis and its importance - crossover experiments-isotopic labelling studies.

Correlation Analysis: Linear Free Energy Relations-Hammet equation - significance - sigma and rho applications and limitations - Taft, Swain-Scott-Grunwald-Winstein equations and their applications, classification of solvents.

UNIT– III STEREOCHEMISTRY I: (15 HOURS)

Optical isomerism - Optical activity and chirality - elements of symmetry - Stereochemistry of overcrowded molecules (hexahelicene, ansa compounds, cyclophanes and trans cycloalkenes -Newmann, Sawhorse and Fischer projections - representation and interconversion - Absolute configuration –

R & S notations for special molecules(allenes, spirans, biphenyls)R-Snomenclature of cyclic chiral compounds - molecules with more than one chiral center. Asymmetric synthesis - Optical purity- determination of enantiomeric excess by NMR – definition of terms like prochirality,enantiotopicanddiastereotopic atoms, groups and faces - stereoselective and stereospecific reactions.

UNIT – IV STEREOCHEMISTRY II (15 HOURS)

Geometrical isomerism : E and Z nomenclature - determination of configuration of geometrical isomers (cyclisation, converting into compounds of known configuration, dipolemoment, converting into less symmetric compounds- spectroscopic methods) configuration of cyclic and bicyclic ring systems - cis- trans nomenclature of three, four and six membered substituted cyclic systems-decalins.

Dynamic Stereochemistry: Quantitative correlation between conformation and reactivity - Winstein-Eliel equation – Curtin- Hammet principle- conformation, reactivity and mechanism of cyclic systems and fused (decalin) ring systems-bridged(norbornane) systems-saponification of an ester - esterification of an alcohol - chromic acid oxidation of cyclohexanols - neighbouring group participation - deamination of 2-amino cyclohexanol.

UNIT – V AROMATICITY AND REAGENTS IN ORGANIC SYNTHESIS (15 HOURS)

Aromaticity: Aromatic character: Five-, six-, seven-, and eight-membered rings-other systems with aromatic sextets– Huckel's theory of aromaticity,Craig's rule- concept of homoaromaticity and antiaromaticity.– NMR concept of aromaticity and antiaromaticity- non benzeniod aromatic compounds-systems with 2,4,8 and 10 electrons, systems of more than 10 electrons (annulenes), Mobius aromaticity. alternant and non-alternant hydrocarbons (azulene type) – aromaticity in heteroaromatic molecules, sdnones and fullerenes.

Reagents in organic synthesis: Oxidation: Baeyer-Villiger, Jacobsen epoxidation, Shi epoxidation, Jones reagent, DMP, TPAP, NOCl, $Mn(OAc)_3$, $Cu(OAC)_2$, Bi_2O_3,Swern oxidation. Reduction: Hydride transfer reagents from group III and group IV in reductions. (i) triacetoxyborohydride, L-selectride, K-selectride, Luche reduction (ii) stereo/enantioselectivity reductions (Chiral Boranes).

UNIT – VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Bamford-Stevens reaction– Barton-McCombie reaction (Barton Deoxygenation)– Baylis- Hillman reaction – Biginelli reaction – Corey-Chaykovsky reaction – Enamines and selective mono- and dialkylation via enamine reactions Henry reaction– Hosomi-Sakurai reaction – Hunsdiecker reaction – Julia olefination and its modifications – Mitsunobu reaction – Mukaiyama-Aldol addition – Nazarov cyclization – Peterson olefination –Prevost reaction– Prins reaction– Staudinger reaction Ugi reaction– Weinreb ketone synthesis – Wittig reaction and its modifications – Yamaguchi macrolactonization –Palladium based reactions: Fukuyama coupling – Heck reaction – Hiyama coupling –Sonogashira coupling– Stille coupling– Suzuki coupling– Tsuji-Trost Reaction.

Total Lecture Hours: 90

COURSE OUTCOMES

The Students Should be able to

1. Apply the basic rules of organic nomenclature to interrelate between structures of organic molecules.
2. Describe the concept of Heterocyclic compounds.
3. Identify the stereo centres in a molecule and assign the configuration.
4. Recognize the Stereo chemical factors.
5. Discuss the mechanisms of the various synthetic reagents and their structure
6. Explain Barton-McCombie reaction

TEXT BOOK(S)

1. Eliel, E. L. (2026). Stereochemistry of Carbon Compounds. McGraw Hill, New Delhi.
2. Clayden, J., Greeves, N., & Warren, S. (2000). Organic Chemistry. Oxford University Press, USA.
3. Kalsi, P. S. (2004). Stereochemistry, Conformations and Mechanism. New Age International Private Limited, New Delhi.
4. March, J., & Smith, M. B. (2013). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure (7th ed.). Wiley, New York.
5. Nasipuri, D. (2020). Stereochemistry of Organic Compounds (4th ed.). New Age International Private Limited, New Delhi.

REFERENCE(S)

1. March, J., & Smith, M. B. (2026). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure (7th ed.). Wiley, New York.
2. Finar, L. (2009). Organic Chemistry, Vol. II (7th ed.). Pearson Education Ltd., New Delhi.
3. Panico, R., Powell, W. H., & Richer, J. C. (1993). A Guide to IUPAC Nomenclature of Organic Compounds.
4. March, J. (2017). Advanced Organic Chemistry: Reaction Mechanisms and Structure. John Wiley, New York.
5. Nasipuri, D. (2019). Stereochemistry of Organic Compounds. New Age International Private Limited, New Delhi.
6. Kalsi, P. S. (2004). Stereochemistry, Conformations and Mechanism. New Age International Private Limited, New Delhi.
7. Ahluwalia, V. K. (2010). Organic Reaction Mechanism. Narosa Publications.
8. Mukherji, M., & Singh, S. P. (1990). Reaction Mechanism in Organic Chemistry. Macmillan India Ltd., Patna.
9. Cahn, R. S., & Dermer, O. C. (1979). Introduction to Chemical Nomenclature. Butterworths, London.
10. Sykes, P. (2004). A Guidebook to Mechanism in Organic Chemistry. Pearson Education, New Delhi.
11. Eliel, E. L. (2003). Stereochemistry of Carbon Compounds. McGraw Hill, New Delhi.
12. Clayden, J., Greeves, N., & Warren, S. (2000). Organic Chemistry. Oxford University Press, USA.

E–RESOURCES

1. https://en.wikipedia.org/wiki/Aromaticity
2. www.springer.com
3. http://www.adichemistry.com/organic/organicreagents/reagents-organic-synthesis.html
4. https://rushim.ru/books/praktikum/Monson.pdf.
5. www.sciencedirect.com

MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
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CO2	3	3	2	2	3	1	1	2	1	2	3	2	2	2	3
CO3	3	3	2	2	2	1	1	2	1	1	3	2	2	2	2
CO4	3	3	3	2	3	1	1	2	1	1	3	2	3	2	3
CO5	3	3	2	3	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	1	1	2	2	3	3	2	3	3	3

Strong - 3 **Medium-2** **Low-1**

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(For the Candidates admitted in the academic year 2026-2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: I- CP- I: Inorganic Chemistry Practical-I

Ins. Hrs. /Week: 6 **Course Credit:4** **Course Code:**P26CH103P

Course objectives:
- To perform the semi-micro qualitative analysis.
- To learn Common cations,and less common cations.
- To estimate the metal ions using colorimeter.

1. **Semi-micro qualitative analysis** of a mixture containing two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Ca, Mg, NH4) and two less common cations (W, Tl, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li).
2. **Estimation** of copper, ferric, nickel, chromium and manganese ions using photoelectric colorimeter

COURSE OUTCOMES
The student should able to

1. Identify the Qualitative analysis of common metals
2. Discuss the Qualitative analysis of rare metals
3. Understand Beer-Lamberts' law
4. Estimate Colorimetric analysis of some common metals
5. Explain Semi-micro qualitative analysis

TEXT BOOK(S)

1. Cotton, F. A., Wilkinson, G., Murillo, C. A., & Bochmann, M. (2026). Advanced Inorganic Chemistry. Wiley India Pvt. Ltd.
2. Huheey, J. E. (2006). Inorganic Chemistry (4th ed.). Harper & Row Publishers, Singapore.
3. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (2003). Inorganic Chemistry: Principles of Structure and Reactivity. Addison-Wesley, New York.
4. Lee, J. D. (1998). Concise Inorganic Chemistry (6th ed.). ELBS, London.
5. Sharma, R. K. (2007). Inorganic Reaction Mechanism. Discovery Publishing House, New Delhi.

REFERENCE BOOKS(S)

1. V. V. Ramanujam, 1988 Inorganic Semimicro Qualitative Analysis; 3rd Ed., National Pubs, London,.
2. G. Svehla, 1987.Macro and Semimicro Qualitative Inorganic Analysis; 5th Ed.,Longman group Ltd, London,
3. Vogel, Text Book of Quantitative Inorganic Analysis;2000 6th Ed., Longman, New Delhi,
4. Willard. H.H, Merritt. L.L , Dean. J.A and Settle. F.A , 1986. Instrumental Methods of Analysis, 6 th Ed., CBS Publishers and Distributors, Chennai.
5. Vogel . A.I. 2026 .Quantitative Inorganic Analysis, 6th Ed., Longman, New Delhi.

E- RESOURCES

1. https://link.springer.com/content/pdf/bfm%3A978-94-017-2744-0%2F1.pdf
2. http://www.freebookcentre.net/chemistry.
3. NCERT – https://ncert.nic.in
4. Institute of Science Nagpur – Study Material http://www.iscnagpur.ac.in/study_material
5. Hindawi Publishing (Research Journals) https://www.hindawi.com

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CO2	3	3	3	2	2	1	2	2	1	1	3	3	3	2	2
CO3	2	2	3	2	1	1	3	2	2	1	2	2	3	1	1
CO4	3	3	3	3	2	1	1	2	1	2	3	3	3	2	2
CO5	3	3	3	2	2	2	1	2	1	2	3	3	3	2	2
CO6	3	3	3	3	3	2	1	2	2	2	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

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DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: I- DCEC IA : COORDINATION CHEMISTRY

Ins. Hrs. /Week: 5 **Course Credit: 4** **Course Code:** P26CHDE11A

COURSE OBJECTIVES:

- To understand the nature, bonding, and structure of coordination compounds.
- To explain the principles of Crystal Field Theory (CFT) and Molecular Orbital Theory (MOT) in coordination chemistry.
- To study the splitting of d-orbitals in different geometries such as octahedral, tetrahedral, and square planar complexes.
- To understand the concepts of strong-field and weak-field ligands and their influence on magnetic and spectral properties.
- To analyze electronic spectra and magnetic behavior of transition metal complexes.

UNIT – I: MODERN THEORIES OF COORDINATION COMPOUNDS (15 HOURS)

Crystal Field Theory: Splitting of d-orbitals in octahedral, tetrahedral and square planar symmetries; measurement of 10Dq; factors affecting 10Dq; spectrochemical series; Crystal Field Stabilization Energy (CFSE) for high-spin and low-spin complexes; evidences for crystal field splitting; site selection in spinels and inverse spinels; Jahn–Teller distortions and their consequences.

Molecular Orbital Theory: Energy level diagrams; concept of weak and strong fields; σ (sigma) and π (pi) bonding in octahedral, square planar and tetrahedral complexes.

UNIT – II: SPECTRAL CHARACTERISTICS OF COMPLEXES (15 HOURS)

Term states for d-electron ions; characteristics of d–d transitions; charge transfer spectra; selection rules for electronic spectra; Orgel correlation diagrams; Tanabe–Sugano energy level diagrams; nephelauxetic series; Racah parameter and calculation of inter-electronic repulsion parameters.

UNIT – III: STABILITY OF COMPLEXES (15 HOURS)

Factors affecting the stability of complexes; thermodynamic aspects of complex formation; stepwise and overall formation constants; stability correlations; statistical factors and chelate effect.

Determination of stability constants and composition of complexes: Formation curves and Bjerrum's half-method, potentiometric method, spectrophotometric method, ion-exchange method, polarographic method and continuous variation method (Job's method).

UNIT – IV: KINETICS AND MECHANISMS OF SUBSTITUTION REACTIONS OF OCTAHEDRAL AND SQUARE PLANAR COMPLEXES (15 HOURS)

Kinetics and mechanism of reactions in solution – labile and inert complexes – ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions
Outer-sphere electron transfer reactions and Marcus–Hush theory; inner-sphere electron transfer reactions; nature of the bridging ligand in inner-sphere electron transfer reactions

.UNIT V: REACTION MECHANISM IN COORDINATION COMPLEXES (15 HOURS)

Trans effect – theory and applications – electron transfer reactions – electron exchange reactions – complementary and non-complementary types – inner sphere and outer sphere processes – application of electron transfer reactions in inorganic complexes – isomerisation and racemisation reactions of complexes.

UNIT – VI: Current Contours (For Continuous Internal Assessment Only – Self Study)

Applications of Crystal Field Theory in Coordination Compounds Electronic Spectra of Transition Metal Complexes , Methods for Determination of Stability Constants of Metal Complexes

TOTAL LECTURE HOURS : 75

COURSE OUTCOMES

Students will be able to:

1. Understand and comprehend various theories of coordination compounds.
2. Understand the spectroscopic and magnetic properties of coordination complexes.
3. Explain the stability of complexes and various experimental methods used to determine stability constants.
4. Predict the electronic transitions in complexes using correlation diagrams and UV–Visible spectral data.
5. Comprehend the kinetics and mechanisms of substitution reactions in octahedral and square planar complexes.
6. Understand photo-isomerisation and other photochemical reactions in complexes and their applications.

TEXT BOOK(S)

1. J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th Edition, Pearson Education, 2006.
2. G. L. Miessler and D. A. Tarr, *Inorganic Chemistry*, 3rd Edition, Pearson Education, 2008.
3. D. Banerjea, *Coordination Chemistry*, Tata McGraw-Hill, 1993.
4. B. N. Figgis, *Introduction to Ligand Fields*, Wiley Eastern Ltd., 1976.
5. F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6th ed.; Wiley Inter-science: New York, 1988.

REFERENCE BOOK(S)

1. Keith F. Purcell and John C. Kotz, *Inorganic Chemistry*, Saunders Publications, USA, 1977.
2. Peter Atkins and Tina Overton, *Shriver and Atkins' Inorganic Chemistry*, 5th Edition, Oxford University Press, 2010.
3. F. A. Cotton, G. Wilkinson and P. L. Gaus, *Basic Inorganic Chemistry*, 3rd Edition, John Wiley & Sons, 2002.
4. B. Douglas, D. McDaniel and J. Alexander, *Concepts and Models of Inorganic Chemistry*, 3rd Edition, John Wiley & Sons, 1994.
5. D. F. Shriver and P. W. Atkins, *Inorganic Chemistry*, W. H. Freeman & Co., London, 2010.

E-RESOURCES

1. https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/
2. www.scribd.com
3. www.icobo.com
4. https://www.studyorgo.com/summary.php
5. www.sciencedirect.com

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2	1	1	2	1	1	3	2	1	2	2
CO2	3	3	2	3	2	1	1	2	1	1	3	3	2	2	2
CO3	3	3	3	3	2	1	1	2	1	1	3	3	3	2	2
CO4	3	3	3	2	3	1	1	2	1	1	3	2	3	2	3
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	2	2	2	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

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(For the Candidates admitted in the academic year 2026 – 2027)

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY

Semester: I - DCEC IB -: Kinetics, Electrochemistry and Thermodynamics

Ins. Hrs. /Week: 5 **Course Credit: 4** **Course code:** P26CHDE11B

COURSE OBJECTIVES:

- Understand the fundamental principles of chemical kinetics.
- Acquire knowledge of advanced kinetic methods, fast reaction techniques.
- Explain the principles of electrochemistry.
- Analyze advanced electrochemical concepts such as electrode kinetics, corrosion, fuel cells, batteries, and electrochemical energy storage systems.
- Apply the laws of thermodynamics to chemical systems .
- Interpret concepts of non-equilibrium thermodynamics and irreversible processes relevant to physical and chemical transformations.

UNIT – I: CHEMICAL KINETICS (15HOURS)

Rate laws and rate constants; determination of reaction order; theories of reaction rates; collision theory and transition state theory; kinetics of complex reactions; chain reactions and catalysis.

UNIT – II: ADVANCED CHEMICAL KINETICS (15 HOURS)

Fast reaction techniques; relaxation methods; flash photolysis; molecular reaction dynamics; homogeneous and heterogeneous catalysis; enzyme kinetics and catalytic mechanisms.

UNIT – III: ELECTROCHEMISTRY (15 HOURS)

Conductance of electrolytic solutions; Debye–Hückel–Onsager theory; ionic atmosphere; transport numbers; electrochemical cells; electrode potentials; Nernst equation; concentration cells and liquid junction potentials.

UNIT – IV: ADVANCED ELECTROCHEMISTRY (15 HOURS)

Electrode kinetics; overvoltage; Butler–Volmer equation; corrosion and its prevention; fuel cells; batteries; electrochemical energy conversion and storage; applications of electrochemistry in industry.

UNIT – V: THERMODYNAMICS (15 HOURS)

Laws of thermodynamics; thermodynamic functions; partial molar properties; chemical potential; fugacity and activity; phase equilibria; thermodynamics of solutions; non-equilibrium thermodynamics and irreversible processes.

UNIT – VI Current Contours (For Continuous Internal Assessment Only – Self Study)
Applications of Chemical Kinetics in Industrial Processes,Modern Catalytic Methods and Green Catalysis Electrochemical Sensors and Their Applications,Recent Advances in Fuel Cell Technology Applications of Thermodynamics in Chemical Systems

TOTAL LECTURE HOURS : 75

COURSE OUTCOMES

Students will be able to:

1. Understand the principles and theories of chemical kinetics.
2. Explain the mechanisms of simple and complex chemical reactions.
3. Apply electrochemical concepts to cells, batteries and corrosion processes.
4. Interpret electrode processes and electrochemical kinetics.
5. Analyze thermodynamic properties and equilibrium systems.
6. Apply thermodynamic principles to chemical and industrial processes.

TEXT BOOK(S)

1. K. J. Laidler, *Chemical Kinetics*, 3rd Edition, Pearson Education.
2. Samuel Glasstone, *Thermodynamics for Chemists*, East-West Press.
3. P. W. Atkins and J. de Paula, *Physical Chemistry*, Oxford University Press.
4. J. O'M. Bockris and A. K. N. Reddy, *Modern Electrochemistry*, Springer.
5. O.P. Vermani, A.K. Narula, Industrial Chemistry, Galgotia publications Pvt. Ltd., New Delhi, 2008.

REFERENCE BOOK(S)

1. I. N. Levine, *Physical Chemistry*, McGraw-Hill.
2. Keith J. Laidler, *Chemical Kinetics*, Harper & Row.
3. Peter Atkins, Julio de Paula and James Keeler, *Atkins' Physical Chemistry*, Oxford University Press.
4. D. A. McQuarrie and J. D. Simon, *Physical Chemistry: A Molecular Approach*, University Science Books.
5. S. Glasstone and D. Lewis, *Elements of Physical Chemistry*, Macmillan.

E-RESOURCES

1. https://ocw.mit.edu
2. https://nptel.ac.in
3. https://chem.libretexts.org
4. www.sciencedirect.com
5. www.khanacademy.org

MAPPING WITH PROGRAM OUTCOMES

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CO5	3	3	2	2	3	1	1	2	1	1	3	2	2	3	3
CO6	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

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DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: I DCEC-IC : Biophysical Chemistry

Ins. Hrs. /Week: 5 **Course Credit: 4** **Course code: P26CHDE11C**

COURSE OBJECTIVES:

- To understand the basic concepts of biological system via physical nature
- To learn the fundamental concepts of bioenergetics and biomolecules
- To study the concepts of biopolymers and its applications.
- To study the biopolymer solutions.
- To study the osmotic pressure.

UNIT– I BIOLOGICAL CELL AND ITS CONSTITUENT: (16 HOURS)

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition. Bioenergetics - Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

UNIT– II STATISTICAL MECHANICS IN BIOPOLYMERS: (16 HOURS)

Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structures. Polypeptide and protein structures, introduction to protein folding problem.

UNIT– III BIOPOLYMER INTERACTIONS: (14 HOURS)

Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria - Various types of binding processes in biological systems. Hydrogen ion titration curves.

UNIT– IV THERMODYNAMICS OF BIOPOLYMER SOLUTIONS:

(14 HOURS)

Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system.

UNIT – V CELL MEMBRANE AND TRANSPORT OF IONS: (15 HOURS)

Structure and functions of cellmembrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction. Biopolymers and their Molecular Weights - Evaluation of size, shape, molecular weight and extent of hydration of biopolymers various experimental techniques. Sedimentation equilibrium, hydrodynamic methods diffusion, sedimentation velocity, viscosity, electrophoresis and rotational motions.

UNIT–VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Equations of motion – potential functions – integration computations – Initial state– boundary conditions– equilibration– dynamics protocols– trajectories– analyses of results – AMBER, CHARM, -simple applications to proteins and nucleic acids Miscellaneous topics

TOTAL LECTURE HOURS : 75

COURSE OUTCOMES

1. Describe the structure and functions of biological cells and major biomolecules.
2. Explain the statistical mechanics of biopolymers.
3. Analyze the intermolecular forces and binding interactions involved in biopolymer systems, including electrostatic, hydrophobic, dispersion forces, and hydrogen ion titration equilibria.
4. Apply the principles of thermodynamics to biopolymer solutions, osmotic pressure, membrane equilibrium, and mechanochemical energy generation.
5. Evaluate the structure and function of cell membranes, ion transport, nerve conduction, and irreversible thermodynamics of membrane transport.
6. Evaluate the molecular weight, size, shape, hydration, and transport properties of biopolymers using experimental techniques

TEXT BOOK(S)

1. Cooper, A. (2011). Biophysical chemistry. Royal Society of Chemistry.
2. Allen, J. P. (2005). Biophysical chemistry. Wiley-VCH.
3. Bergethon, P. R., & Simons, E. R. (1990). Biophysical chemistry: Molecules to membranes. Springer.
4. Kalidas, C., & Sangaranarayanan, M. V. (2026).
5. Biophysical chemistry: Techniques and applications. Springer Nature.

REFERENCE(S)

1.Principles of Biochemistry, A. L. Lehninger,Worth Publishers.
2. Biochemistry, J.DavidRawn, Neil Patterson
3..Biochemistry, Voet and Voet, John Wiley Publication.
4. Outlines of Biochemistry, E. E. Conn and P. K. Stumpf, John Wileyub
5. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H.Dugasand C.Penny,Springer-verlag
6. Macromolecules: Structure and Function, F.World. Prentice Hall.

E-Resources

1. https://ocw.mit.edu
2. https://nptel.ac.in
3. www.link.Chem LibreTexts
4. www.ScienceDirect
5. https://Springer Nature Chemistry Collection

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	3	2	3	1	1	2	1	2	3	2	2	3	3
CO3	3	3	3	3	2	1	1	2	1	2	3	3	3	2	2
CO4	3	3	3	3	3	1	2	2	1	2	3	3	3	3	3
CO5	3	3	2	2	3	1	1	2	1	1	3	2	2	3	3
CO6	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

SUNDARAKKOTTAI, MANNARGUDI- 614016

(For the Candidates admitted in the academic year 2026 – 2027)

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY

Semester: I-GEC - 1A : Food Chemistry

Ins. Hrs. /Week :5 **Course Credit: 3** **Course Code:** P26CHGE11A

COURSE OBJECTIVES

- To understand the nutritional importance of proteins, carbohydrates, fats, oils, vitamins, and water in human health.
- To acquire knowledge of the sources, functions, recommended dietary allowances, and deficiency disorders associated with nutrients.
- To understand the effects of cooking and food processing on the nutritional quality of foods and develop awareness of healthy food habits.S
- To learn the principles and methods of food preservation and their role in preventing food spoilage.
- To gain knowledge of food adulteration, its detection, prevention, and the importance of ensuring food qualityand safety.

UNIT I: NUTRIENTS–I **(15 Hours)**

Protein–functions, sources, deficiency diseases, daily allowances. Carbohydrates–functions, sources, deficiency diseases, daily allowances. Fats and oils–functions, sources, deficiency diseases, daily allowances, disorders due to excess of fat.

UNIT-II:NUTRIENTS–II **(15 Hours)**

Vitamins – H2O soluble and fat soluble vitamins – sources, functions, deficiency and disorders of taking excess of vitamins. H2O–functions, sources, deficiency diseases

UNIT - III: FOOD PREPARATION **(16 Hours)**

Food preparation-Effect of cooking and heat processing on the nutritive value of foods. Food faddism and faulty food habits. Cooking methods: Moist heat methods and dry heat methods–merits and demerits. Preparation of Essence, Hand wash, Disinfectants and Antiseptic agents.

UNIT - IV: FOOD PRESERVATION **(14 HOURS)**

Food preservation: Importance of food preservation, causes of food spoilage. Principles of food preservation. Home scale methods of food preservation.

Methods of food preservation: Low temperature, high temperature, preservatives, osmotic pressure, dehydration, irradiation–merits and demerits.

UNIT - V: FOOD ADULTERATION (15 HOURS)

Food Adulteration–Types, international, Metallic, incidental adulteration and their ill effects. Simple physical and chemical tests for detection of food adulterants, consumer protection.

UNIT-VI: Current Contours (For Continuous Internal Assessment Only – Self Study)

Balanced diet and meal planning for different age groups. Nutritional requirements during pregnancy, lactation, infancy, childhood and old age. Malnutrition – causes, symptoms and prevention. Nutritional disorders such as obesity, diabetes, hypertension and anemia. Food hygiene and sanitation

TOTAL LECTURE HOURS: 90

COURSE OUTCOMES

The student Should able to,

1. Discuss the functions, sources, deficiency diseases and daily allowances of major nutrients
2. Understand various kinds of Vitamins, Sources, functions and deficiency symptoms
3. Describe the different types of food adulteration.
4. Learn the food preservation, causes of food spoilage
5. Learn the diabetes, hypertension and anemia

TEXT BOOK(S)

1. Belitz. W. Grosch, P.Schieberle,2009, Food Chemistry, 4th Edition Oxford University Press, New York,..
2. Deman. J.M.(et al), 2018, Principles of Food Chemistry. University of Guelph. Guelph, Ontario.
3. Hamilton. R.J, 1998, Lipid Analysis in Oils and Fats.University Liverpool UK
4. Srilakshmi. B, 2026, Food Sceince, Third Edition, New Age international publishers.New Delhi.
5. Swaminathan. Dr. M, 2008, Handbook of food and Nutrition 'Reprint, published by The Bangalore printing and publishing co. ltd.NewDelhi.

REFERENCE BOOK(S)

1. Lakshmi, 2000. Food Science, Second Edition, New Age international publishers.New Delhi.
2. Sumathi. R. Mudambi,1983. 'Fundamentals of food and Nutrition', Second edition, Wiley Eastern Limited.New Delhi.
3. Swaminathan.M. Dr.1987. Food Science Chemistry and Experimental foods, second

enlargededition, Published by Bangalore press.

4. Swaminathan. M. Dr. 'Advanced test Book on Food and Nutrition Volume I and II second edition, The printing and publishing co. ltd .Bangalore.
5. Swaminathan .M.2026. Dr.'Advanced test Book on Food and Nutrition Volume III secondedition, The printing and publishing co. ltd. Bangalore

E RESOURCES

1. www.bing.com/aclick
2. https://medical-dictionary.thefreedictionary.com/nutrient
3. https://nios.ac.in/media/documents/srsec321newe/321-e-lesson-8.pdf
4. www.eagri.org/eagri50/ambe101/pdf/lec23.pdf
5. http://ijsit.com/admin/ijsit_files/food%20adulteration_1.2.4.pdf

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	3	2	3	1	1	2	1	2	3	2	2	3	3
CO3	3	3	3	3	2	1	1	2	1	2	3	3	3	2	2
CO4	3	3	3	3	3	1	2	2	1	2	3	3	3	3	3
CO5	3	3	2	2	3	1	1	2	1	1	3	2	2	3	3
CO6	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

Strong - 3 Medium-2 Low-1

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DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: I-GEC - IB: Forensic Chemistry

Ins. Hrs. /Week :5 **Course Credit: 3** **Course Code:** P26CHGE11B

COURSE OBJECTIVES

- Understand the scope, significance, and interdisciplinary nature of forensic chemistry in criminal investigations.
- Gain knowledge of the procedures involved in the collection, preservation, handling, and analysis of forensic evidence .
- Classify and identify toxic substances and understand the principles of forensic toxicology.
- Apply chromatographic, spectroscopic, and other instrumental techniques.
- Understand the forensic investigation of explosives, arson cases, questioned documents.
- Acquire knowledge of forensic biochemical methods including blood analysis, body fluid examination, DNA profiling, and fingerprint identification.

UNIT – I: INTRODUCTION TO FORENSIC CHEMISTRY (16 HOURS)

Scope and significance of forensic chemistry; role of forensic scientists in crime investigation; branches of forensic science; collection, preservation and analysis of physical evidence; chain of custody and ethics in forensic investigations.

UNIT – II: FORENSIC ANALYSIS OF TOXIC SUBSTANCES (14 HOURS)

Classification of poisons; toxicological analysis; detection and identification of toxic substances in biological samples; alcohol and drug analysis; forensic significance of poisoning cases.

UNIT – III: FORENSIC EXAMINATION OF TRACE EVIDENCE (15 HOURS)

Analysis of hair, fibres, glass, paint, soil and metal traces; principles and applications of chromatography and spectroscopy in forensic investigations; instrumental methods used in trace evidence examination.

UNIT – IV: FORENSIC ANALYSIS OF EXPLOSIVES, ARSON AND DOCUMENTS (15 HOURS)

Classification and identification of explosives; investigation of fire and arson cases; examination of questioned documents; analysis of inks, papers, handwriting, signatures and counterfeit currency.

UNIT – V: FORENSIC BIOCHEMISTRY AND MODERN FORENSIC TECHNIQUES (15 HOURS)

Blood and body fluid analysis; DNA profiling and fingerprinting; forensic applications of molecular biology; cyber forensics; recent advances and applications of forensic chemistry in criminal investigations.

UNIT – VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Cyber Forensics and Digital Evidence Analysis ,Environmental Forensics and Pollution Analysis Case Studies in Forensic Toxicology and DNA Analysis.

TOTAL LECTURE HOURS : 75

COURSE OUTCOMES

Students will be able to:

1. Understand the fundamentals and scope of forensic chemistry.
2. Explain the collection, preservation and analysis of forensic evidence.
3. Identify and analyze toxic substances and drugs in forensic samples.
4. Apply instrumental techniques for the examination of trace evidence.
5. Understand the forensic investigation of explosives, arson and questioned documents.
6. Comprehend the applications of DNA profiling and modern forensic techniques in crime investigation.

TEXT BOOK(S)

1. Saferstein, R. (2023). Criminalistics: An introduction to forensic science (13th ed.). Pearson Education.
2. Houck, M. M., & Siegel, J. A. (2015). Fundamentals of forensic science (3rd ed.). Academic Press.
3. Sharma, B. R. (2014). Forensic science in criminal investigation and trials (5th ed.). Universal Law Publishing.
4. Bell, S. (2013). *Forensic chemistry* (2nd ed.). Pearson Education.
5. Saferstein, R. (2026). *Criminalistics: An introduction to forensic science* (13th ed.). Pearson.

REFERENCE BOOK(S)

1. Bell, S. (2013). Forensic chemistry. Pearson Education.
2. White, P. C. (2010). Crime scene to court: The essentials of forensic science. Royal Society of Chemistry.
3. Mozayani, A., & Noziglia, C. (2011). The forensic laboratory handbook procedures and practice. Humana Press.
4. James, S. H., Nordby, J. J., & Bell, S. (2014). Forensic science: An introduction to scientific and investigative techniques (4th ed.). CRC Press.
5. Robertson, J., & Roux, C. (2026). Forensic examination of fibres (3rd ed.). CRC Press.

E-RESOURCES

1. www.sciencedirect.com
2. www.nptel.ac.in
3. National Forensic Sciences University (NFSU)
   http://www.nfsu.ac.in
4. National Institute of Justice (NIJ) – Forensic Science Resources
   https://nij.ojp.gov/topics/forensics
5. https://www.rsc.org/journals-books-databases/about-journals/analytical-methods/forensic-science

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	3	2	3	1	1	2	1	2	3	2	2	3	3
CO3	3	3	3	3	2	1	1	2	1	2	3	3	3	2	2
CO4	3	3	3	3	3	1	2	2	1	2	3	3	3	3	3
CO5	3	3	2	2	3	1	1	2	1	1	3	2	2	3	3
CO6	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

Strong - 3 Medium-2 Low-1

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DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: I-GEC - IC: CATALYSIS

Ins. Hrs. /Week :5 **Course Credit: 3** **Course Code:** P26CHGE11C

COUSE OBJECTIVES:

- To understand the basic concepts of catalysis
- To know the different methods of catalysis
- To learn the various techniques and mechanisms involved in catalysis.
- To understand the Phase transfer catalysis
- To know the biocatalysisand mechanism of Enzymes.

UNIT– I INTRODUCTION TO CATALYSIS: (15 HOURS)

Activity, selectivity, promoters, stabilisers and poisons, Catalysts deactivation, Turn overnumber, inhibitors. Thermodynamic consideration in catalysis: Energy factor, significance of activationparameters and application to kinetic systems. Physical adsorption-Unimolecular adsorption- types of adsorption isotherms, Multimolecular adsorption-BET method, Harkins-Jura equation.Chemisorption of gases onmetals and oxides.

UNIT– II HOMOGENEOUS AND HETEROGENEOUS CATALYSIS:

(15 HOURS)

Acid-base catalytic reactions, protolytic and protropic mechanisms, activation energy of theprocesses, catalytic activity and acid-base strength, acidity functions: Hammett-Zuckertreatments, linear free energy relationships. Homogeneous catalysts for the polymerization of olefins, oxidative dehydrogenation, Ethylbenzene to styrene, Ziegler-Natta polymerization. Partial oxidation: n- butane to maleic anhydride, propylene to acrolene, Fisher- Tropschsynthesis, catalytic reaction of cracking, shape selective catalysis: Zeolites-Alkylation of aniline with alcohols. Catalysts for the production of petrochemicals- production of aromatics, para-xylene, cumene, linear alkylbenzenes and methanol.

Phase transfer catalysis – Rhodium water soluble catalyst systems with carboxylated and sulfonatedphosphines for hydroformylation reactions.

UNIT –III PHOTOCATALYSIS: (15 HOURS)

Thermal and photochemical reactions between H_2-Cl_2 and H_2-Br_2 and H_2- I_2 reactions, fluorescence, phosphorescence and quenching-Stern-Volmer equation.

Photocatalytic studies using non-stoichiometric oxides such as n-type and p-type semiconductors (TiO_2, ZnO, Cr_2O_3, doped and coupled semiconductors for the degradationof dyes)

UNIT– IV ELECTROCATALYSIS: (15 HOURS)

Solar energy conversion, electrochemical cells, photoelectrolysis of water and photocatalytic reactions Photocatalytic reduction of dinitrogen, photocatalysisfor organic reactions oxidation, reduction, polymerization, substitution and isomerization reaction using TiO_2.

UNIT– V BIOCATALYSIS: MECHANISM AND APPLICATION: (15 HOURS)

Mechanisms: Covalent catalysis, acid-base and metal-ion catalysis, entropy and geometric effects,structural complementary of the active site to the transition state, prevention of the side reactions, the size of the enzymes. Applications of enzymes in organic synthesis: Oxidoreductase: Oxidation - Alcohols, epoxides, sulfoxides, amino acids, lactones, Oxidoreductase: Reduction-α-hydroxyaminoacid, Transferase: Amino acids, amines.

UNIT– VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Structural characterization-BET surface area method, pore volume, and pore size distribution-BJH method, t-plot method, XRD, SEM, TEM, AFM, STM, TPR and TPD. Special relevance to metal oxides with different structures

COURSE OUTCOMES:

1. Explain the fundamental concepts of catalysis, including catalyst activity, selectivity, adsorption phenomena, catalyst deactivation, and thermodynamic aspects governing catalytic reactions.
2. Apply the principles of homogeneous and heterogeneous catalysis to industrial and petrochemical processes.
3. Analyze the mechanisms of photochemical and photocatalytic reactions involving semiconductor materials and dye degradation.
4. Apply the concepts of electrocatalysis and photocatalysis in solar energy conversion, water splitting, and organic transformations.
5. Evaluate the mechanisms and applications of biocatalysis in enzyme-catalyzed organic synthesis.
6. Evaluate the structural and surface characteristics of catalysts using advanced characterization techniques such as BET, BJH, XRD, SEM, TEM, AFM, STM, TPR, and TPD.

TEXT BOOK(S)

1. Chorkendorff, I., & Niemantsverdriet, J. W. (2017). Concepts of modern catalysis and kinetics (3rd ed.). Wiley-VCH.
2. Thomas, J. M., & Thomas, W. J. (2014). Principles and practice of heterogeneous catalysis (2nd ed.). Wiley-VCH.
3. Masel, R. I. (2026). Chemical kinetics and catalysis. Wiley-Interscience.

4. Fogler, H. S. (2020). Elements of chemical reaction engineering (6th ed.). Pearson Education.
5. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy, Catalysis: Principles and Applications, Narosa Publishing House, New Delhi, 2004

REFERENCE(S)

1. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy, Catalysis: Principles and Applications, Narosa Publishing House, New Delhi, 2004
2. G.C. Bond, Heterogeneous catalysis: Principles and applications, Oxford University Press,Ely House, London W.I, 1974.
3. V. Murugesan, A. Banumathi and M. Palanichamy, Recent Trends in Catalysis, Narosa Publishing House, New Delhi, 1999.
4. K.J. Laidler, Chemical Kinetics, Tata Mcgraw-Hill Publishing Company Ltd, New Delhi, 1973.
5. D.K. Chakrabarty, Adsorption and Catalysis by solids, Wiley Eastern Limited, New Delhi, 1991.
6. J.M Thomas, W.J. Thomas, Principles and practice of Heterogeneous Catalysis, Wiley- VCH, New York, 1996.

E-RESOURCES

1. https://ocw.mit.edu
2. https://nptel.ac.in
3. www.rsc.org/journals-books-databases/about-journals/catalysis-science-technology/
4. www.sciencedirect.com
5. https://pubs.acs.org/journal/accacs
6. https://link.springer.com

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	3	2	3	1	1	2	1	2	3	2	2	3	3
CO3	3	3	3	3	2	1	1	2	1	2	3	3	3	2	2
CO4	3	3	3	3	3	1	2	2	1	2	3	3	3	3	3
CO5	3	3	2	2	3	1	1	2	1	1	3	2	2	3	3
CO6	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
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(For the Candidates admitted in the academic year 2026 – 2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: I-SEC-I : CHEMISTRY OF CONSUMER PRODUCTS

Ins. Hrs. /Week :2 **Course Credit: 2** **Course Code:** P26SECH11

COURSE OBJECTIVES

- Understand the composition, manufacture, properties, and cleansing mechanisms of soaps, detergents,
- Acquire knowledge of the classification,
- Ingredients, and quality control measures of cosmetics and personal care products.
- Explain the chemistry and functions of food additives such as preservatives, antioxidants, flavouring agents, colouring agents, sweeteners, and emulsifiers in food products.
- Analyze the chemical composition and preparation of common beverages including soft drinks, tea, coffee, and energy drinks, along with relevant food safety regulations.
- Understand the types, properties, applications, and environmental impacts of polymers, plastics, and packaging materials used in consumer products.

UNIT – I: SOAPS, DETERGENTS AND CLEANING AGENTS (6 HOURS)

Soaps and detergents: Composition, manufacture and cleansing action; types of detergents; additives used in detergents; shampoos, toilet soaps, dishwashing agents and disinfectants; environmental impact of detergents.

UNIT – II: COSMETICS AND PERSONAL CARE PRODUCTS (6 HOURS)

Classification of cosmetics; ingredients and formulation of skin creams, lotions, talcum powders, lipsticks, perfumes, deodorants and hair-care products; safety aspects and quality control of cosmetic products.

UNIT – III: FOOD ADDITIVES AND BEVERAGES (6 HOURS)

Food preservatives, antioxidants, flavouring agents, colouring agents, sweeteners and emulsifiers; composition and chemistry of soft drinks, tea, coffee and energy drinks; food safety and regulations.

UNIT – IV: POLYMERS, PLASTICS AND PACKAGING MATERIALS (6 HOURS)

Types of plastics and polymers used in consumer products; biodegradable and non-biodegradable plastics; packaging materials; recycling and environmental concerns associated with plastic waste.

UNIT – V: HOUSEHOLD AND HEALTHCARE PRODUCTS (6 HOURS)

Chemistry of paints, adhesives, insect repellents and pesticides; over-the-counter healthcare products; antiseptics, disinfectants and sanitizers; consumer awareness and safe handling of household chemicals.

UNIT – VI: Current Contour (For Continuous Internal Assessment Only - Self study)

Green consumer products; eco-friendly detergents and cosmetics; biodegradable packaging materials; natural preservatives; sustainable product development; consumer product safety regulations; recent innovations in household, cosmetic and food products.

TOTAL LECTURE HOURS : 30

COURSE OUTCOMES

Students will be able to:

1. Understand the chemistry behind common consumer products.
2. Explain the composition and applications of soaps, detergents and cleaning agents.
3. Describe the formulation and safety aspects of cosmetic and personal care products.
4. Understand the role of additives in food and beverages.
5. Evaluate the environmental impact of plastics and packaging materials.
6. Demonstrate awareness regarding the safe use and disposal of household and healthcare products.

TEXT BOOKS

1. Barel, A. O., Paye, M., & Maibach, H. I. (Eds.). (2014). Handbook of cosmetic science and technology (4th ed.). CRC Press.
2. Ebewele, R. O. (2000). Polymer science and technology. CRC Press.
3. Rosen, M. J., & Kunjappu, J. T. (2012). Surfactants and interfacial phenomena (4th ed.). Wiley.
4. Brady, J. E., Clauser, H. R., & Vaccari, J. A. (2017). Chemistry of consumer products (3rd ed.). Wiley.
5. Emsley, J. (2026). Vanity, vitality, and virility: The science behind the products you love to buy. Oxford University Press.

REFERENCE BOOKS

1. Butler, H. (Ed.). (2000). Poucher's perfumes, cosmetics and soaps (10th ed.). Springer.
2. George, M. A. (2009). The chemistry of household products. Royal Society of Chemistry.
3. Ash, M., & Ash, I. (2009). Handbook of preservatives. Synapse Information Resources.
4. Flick, E. W. (1991). Cosmetic and toiletry formulations (2nd ed.). Noyes Publications.
5. Ebnesajjad, S. (2013). Handbook of biopolymers and biodegradable plastics. William Andrew Publishing.

E-RESOURCES

1. https://edu.rsc.org
2. **American Chemical Society – Chemistry for Life**
   https://www.acs.org
3. **ScienceDirect**
   https://www.sciencedirect.com
4. **NPTEL Online Courses**
   https://www.nptel.ac.in
5. **Chemguide – Free Chemistry Learning Resource**
   https://www.chemguide.co.uk

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	3	2	3	1	1	2	1	1	3	2	2	3	3
CO3	3	3	3	3	2	1	1	2	1	2	2	3	3	2	2
CO4	3	3	3	3	3	1	2	2	1	2	3	3	3	3	3
CO5	3	3	2	2	3	1	1	2	1	1	3	2	2	3	3
CO6	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

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DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester-I: VAC-I ADVANCED AI APPLICATIONS IN CHEMISTRY AND MOLECULAR SCIENCES

Ins. Hrs. /Week:2 **Course Credit: 2** **Course Code:**P26CHVA11

COURSE OBJECTIVES

- To provide advanced knowledge of artificial intelligence tools used in chemical research.
- To develop understanding of machine learning, predictive modeling and cheminformatics applications.
- To familiarize students with AI-assisted analytical techniques, molecular modeling and smart laboratories.
- To explore automation and digital workflows in chemical sciences.
- To enhance research productivity using AI-enabled scientific tools.

UNIT–I: FOUNDATIONS OF AI IN ADVANCED CHEMISTRY (5 HOURS)

Introduction to Artificial Intelligence in chemical sciences. AI, Machine Learning, and computational chemistry. AI-assisted scientific computation. AI in chemical laboratories and research. AI in cheminformatics and molecular sciences. Opportunities and challenges of AI in chemistry. Emerging trends in computational chemistry. AI-assisted scientific communication**.**

UNIT–II: AI-ASSISTED ORGANIC, INORGANIC AND REACTION CHEMISTRY (5 HOURS)

AI-assisted reaction prediction. AI in synthetic chemistry. AI-assisted retrosynthetic analysis. Molecular structure interpretation using AI. AI in stereochemistry and conformational analysis. AI-assisted coordination chemistry analysis. AI in catalytic reaction systems. Applications in advanced synthetic chemistry.

UNIT–III: AI IN SPECTROSCOPY, ANALYTICAL CHEMISTRY AND QUANTUM CHEMISTRY (5 HOURS)

AI-assisted spectroscopy interpretation. AI in NMR, IR, UV-Visible, and Mass spectroscopy. AI-assisted chromatographic analysis. AI in electrochemical systems. AI-assisted quantum chemistry concepts. AI in molecular orbital interpretation. AI-assisted analytical instrumentation. Applications in chemical analytics.

UNIT–IV: AI APPLICATIONS IN COMPUTATIONAL CHEMISTRY AND MATERIALS SCIENCE (5 HOURS)

AI-assisted molecular modeling. AI in computational chemistry. AI-assisted molecular property prediction. AI in materials discovery. AI-assisted nanomaterial analysis. AI in quantum chemical simulations. AI-assisted computational materials science. AI in smart

materials and energy systems.

UNITUNIT–V: AI IN DRUG DISCOVERY, RESEARCH ANALYTICS AND FUTURE CHEMISTRY (5 HOURS)

AI-assisted drug discovery. AI in molecular docking concepts. AI-assisted pharmaceutical chemistry. AI in biomolecular interaction prediction. AI-assisted scientific literature review. AI in autonomous laboratories and robo-labs. Ethical considerations in AI-assisted chemistry. Future of AI in chemical sciences and industry.

UNIT–VI: Current Contours (For Continuous Internal Assessment Only – Self Study)
Students shall independently complete AI-assisted chemistry learning activities.

TOTAL LECTURE HOURS: 30

COURSE OUTCOMES
Students will be able to

1. Understand the foundations of Artificial Intelligence and machine learning in chemical sciences.
2. Apply AI tools for chemical data analysis and spectral interpretation.
3. Utilize cheminformatics and molecular modeling techniques in research.
4. Evaluate AI applications in analytical chemistry and materials science.
5. Analyze the role of smart laboratories and automation in modern chemical research.
6. Apply Future of AI in chemical sciences and industry

TEXTBOOK(S)

1. Cartwright, H. M. (2026). *Artificial intelligence in chemistry*. Royal Society of Chemistry.
2. Gasteiger, J., & Engel, T. (Eds.). (2003). *Chemoinformatics: A textbook*. Wiley-VCH.
3. Leach, A. R. (2021). *Molecular modelling: Principles and applications* (2nd ed.). Pearson Education.
4. Leach, A. R., & Gillet, V. J. (2007). *An introduction to chemoinformatics* (Rev. ed.). Springer.
5. Cramer, C. J. (2023). *Essentials of computational chemistry: Theories and models* (2nd ed.). Wiley.

REFERENCE BOOKS

1. Jensen, F. (2017). *Introduction to computational chemistry* (3rd ed.). Wiley.
2. Hinchliffe, A. (2008). *Molecular modelling for beginners* (2nd ed.). Wiley.
3. Brown, S. D., Tauler, R., & Walczak, B. (Eds.). (2009). *Comprehensive chemometrics: Chemical and biochemical data analysis*. Elsevier.
4. Goodfellow, I., Bengio, Y., & Courville, I. (2016). *Deep learning*. MIT Press.
5. Bishop, C. M. (2022). *Pattern recognition and machine learning*. Springe

E-RESOURCES

1. https://pubchem.ncbi.nlm.nih.gov
2. www.chemspider.com
3. www.rcsb.org
4. https://scholar.google.com
5. https://autodock.scripps.edu

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	2	2	3	1	2	3	2	1	2	2
CO2	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO3	3	3	3	3	3	1	1	2	1	2	3	3	3	3	3
CO4	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO5	3	3	2	3	3	2	3	2	1	3	3	3	2	3	3
CO6	3	3	2	3	3	2	2	3	2	3	3	3	2	3	3

Strong - 3 **Medium-2** **Low-1**

SEMESTER II

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
SUNDARAKKOTTAI, MANNARGUDI- 614016
(For the Candidates admitted in the academic year 2026-2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: II-CC- III : Organic Chemistry – II

Ins. Hrs. /Week: 6 **Course Credit: 4** **Course code:** P26CH204

COURSE OBJECTIVES

- Understand and explain the mechanisms, stereochemistry, aAnalyze the principles governing addition and elimination reactions, including
- Regioselectivity, stereoselectivity, reaction mechanisms, and structure–reactivity relationships.
- Apply the concepts of substituent effects,
- Acquire knowledge of the synthesis, properties, and reactivity of non-aromatic and aromatic heterocyclic compounds of biological and industrial importance.
- Develop an understanding of the biosynthesis, synthesis, structure, and significance of natural products.

UNIT – I: NUCLEOPHILIC SUBSTITUTION REACTIONS (18 HOURS)

Aliphatic nucleophilic substitution: Mechanisms – SN^1, SN^2 and SN^i; ion pairs in SN^1 mechanisms; neighbouring group participation; non-classical carbocations; substitutions at allylic and vinylic carbons.

Reactivity: Effect of structure, nucleophile, leaving group and stereochemical factors; correlation of structure with reactivity; solvent effects; rearrangements involving carbocations – Wagner–Meerwein and dienone–phenol rearrangements.

Aromatic nucleophilic substitution: SN^1

SNAr and benzyne mechanisms; reactivity and orientation; Ullmann, Sandmeyer and Chichibabin reactions; rearrangements involving nucleophilic substitution – Stevens, Sommelet–Hauser and von Richter rearrangements.

UNIT – II: ELECTROPHILIC SUBSTITUTION REACTIONS (19 HOURS)

Aromatic electrophilic substitution reactions: Orientation, reactivity and mechanisms based on transition state theory; electrophilic substitutions in thiophene and pyridine N-oxide; quantitative treatment of structural effects on reactivity.

Substituent effects: Origins of sigma (σ) and rho (ρ) constants; principles of the Hammett equation; substituent effects and applications in organic reaction mechanisms; correlation of structure with reactivity; Hammett parameters (σ and ρ); modified forms of the Hammett equation; Taft equation.

Aliphatic electrophilic substitution: SE1, SE2 and SEi mechanisms; diazonium coupling reactions; metals as electrophiles in substitution reactions; decomposition of diazonium salts.

UNIT – III: ADDITION AND ELIMINATION REACTIONS (17 HOURS)

Addition to carbon–carbon multiple bonds: Electrophilic, nucleophilic and free-radical additions; orientation of addition; stereochemical factors influencing the addition of bromine and hydrogen bromide; hydroxylation; 1,2-dihydroxylation; hydroboration leading to alcohol formation; oxidation and ozonolysis.

Addition to carbonyl and conjugated carbonyl systems: Mechanisms; Grignard reagents; 1,2- and 1,4-additions (lithium dimethylcuprate); addition to carbon–oxygen double bonds; Benzoin, Knoevenagel, Stobbe, Darzens glycidic ester and Reformatsky reactions.

Elimination reactions: Mechanisms of E1, E2 and E1CB reactions; stereochemistry of elimination; Hofmann and Zaitsev rules; competition between elimination and substitution; pyrolytic cis-elimination; Chugaev reaction; dehydration; dehydrohalogenation; Hofmann degradation; Cope elimination; Bredt's rule and applications.

UNIT – IV: HETEROCYCLES (17 HOURS)

Non-aromatic heterocycles: Synthesis of tetrahydrofurans, pyrrolidines, tetrahydropyrans and piperidines. Synthesis of heterocycles: Aziridines, oxiranes, thiiranes, azetidines, oxetanes, oxazoles, imidazoles and thiazoles. Synthesis and reactivity of aromatic heterocycles: Pyrazoles, isothiazoles, triazoles, pyrimidines, purines, triazines and pyrazines.

UNIT – V: NATURAL PRODUCTS (For Continuous Internal Assessment Only - Self study

(19 HOURS)

Terpenoids: Introduction; biosynthesis of menthol and camphor; total synthesis – Takasago synthesis of menthol, Corey's synthesis of longifolene and Curran's synthesis of hirsutene.

Steroids: Introduction; partial synthesis of androsterone and testosterone from cholesterol; total synthesis – Johnson's synthesis of progesterone and Vollhardt's synthesis of estrone.

Alkaloids: Introduction; biosynthesis of nicotine and camptothecin; total synthesis – Corey's synthesis of epibatidine, Comins' asymmetric synthesis of camptothecin and Woodward's synthesis of reserpine.

UNIT – VI: Current Contours (For Continuous Internal Assessment Only – Self Study)

Occurrence, nomenclature and general methods of structure determination of anthocyanidins. Synthesis of cyanidin chloride, chalcones, flavones and quercetin.

Prostaglandins: Occurrence, classification, biogenesis, physiological effects and synthesis of PGE_2 and $PGF_{2\alpha}$.

Pyrethroids, rotenones and pheromones: Natural and synthetic pyrethroids; rotenones and pheromones; synthesis of bombykol.

TOTAL LECTURE HOURS : 90

COURSE OUTCOMES

The student should able to

1. Understand the Nucleophilic aliphatic Substitution reactions.
2. Explain rearrangement process.
3. Gain more knowledge of Electrophilic Aromatic Substitution
4. Identify the Electrophilic Aliphatic Substitution reactions.
5. Analyse importance of natural products.
6. Study the aspects of aliphatic nucleophilic and aromatic nucleophilic substitution reactions and its applications. To appreciate the principles of addition reactions

TEXTBOOK(S)

1.Bansal . R. K. 2019. Organic Reaction Mechanism.11 Edition. Tata Mc Graw Hill, Noida.

2.Finar. L. 2009 . Organic Chemistry. Vol.II, 7 th Edition. Pearson education Ltd, New Delhi.

3.Jerry March. 2025. Advanced Organic Chemistry . Reaction Mechanisms and Structure,

4.Lowry .T. H. E and Richardson . K. S.1997. Mechanism and Theory in Organic

5.Morrison . R.T. and Boyd . R.N.2018. " Organic Chemistry" (6th edition), New York, Allyn & Bacon Ltd.,

6.O.P. Agarwal . 2015, "Natural products", Krishna Prakashan media Pvt Ltd, Uttar Pradesh.

REFERENCE(S)

1. March, J. (2026). Advanced Organic Chemistry: Reaction Mechanisms and Structure. John Wiley, New York.
2. Bansal, R. K. (2006). Organic Reaction Mechanisms (11th ed.). Tata McGraw-Hill, Noida.
3. Clayden, J., Greeves, N., Warren, S., & Wothers, P. (2012). Organic Chemistry (2nd ed.). Oxford University Press, UK.
4. Carey, F. A., & Sundberg, R. J. (2023). Advanced Organic Chemistry: Part A and Part B (5th ed.). Springer, Germany.
5. Finar, L. (2009). Organic Chemistry (Vol. II, 7th ed.). Pearson Education Ltd., New Jersey.
6. Carey, F. A., & Sundberg, R. J. (2008). Advanced Organic Chemistry (Vol. II, 5th ed.). Springer, Berlin. (Reference for Longifolene)

E-RESOURCES

1.https://www.sciencedirect.com/topics/materials-science/nucleophilic-substitution

2.https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Organic_Chemistry_with_a_Bilogical_Emphasis_v2.0_(Soderberg)/08%3A_Nucleophilic_Substitution_Reactions

3.https://chem.libretexts.org/Ancillary_Materials/Reference/Organic_Chemistry_Glossary/Addition-Elimination_Mechanism

4.https://www.masterorganicchemistry.com/2013/01/22/addition-reactions-the-opposite-of-elimination/

5.https://www.nature.com/subjects/natural-products

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	2	2	3	1	1	2	1	1	3	2	1	2	3
CO3	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO4	3	3	2	2	2	1	1	2	1	1	3	2	2	2	2
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
SUNDARAKKOTTAI, MANNARGUDI- 614016
(Affiliated to Bharathidasan University, Tiruchirappalli)
SUNDARAKKOTTAI, MANNARGUDI–614016.
(For the Candidates admitted in the academic year 2026 – 2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: II - CC IV -: PHYSICAL CHEMISTRY I

Ins. Hrs. /Week: 6 **Course Credit: 4** **Course code:** P26CH205

COURSE OBJECTIVES:

- To understand the fundamental principles of chemical kinetics and the theories governing reaction rates and reaction mechanisms.
- To study the concepts of photochemistry and radiation chemistry, including photochemical reactions and the interaction of radiation with matter.
- To understand the principles of quantum mechanics and their applications to atomic and molecular systems.
- To learn the fundamentals of group theory and its application in molecular symmetry and spectroscopy.
- To acquire knowledge of statistical thermodynamics and its application to the interpretation of thermodynamic properties and molecular behavior.

UNIT – I CHEMICALKINETICS I (18 HOURS)

Theories of reaction rate based on statistical mechanics –statistical mechanics and chemical equilibrium-Transition state theory based on statistical mechanics- symmetry numbers and statistical factors- transmission coefficient- reaction coordinate – potential energy surfaces – kinetic isotope effect – Hinshelwood theory– Kassel, Rice and Ramsperger theory (KRRT)– Slater's treatment.

Principle of microscopic reversibility – steady-state approximation – chain reactions: thermal and photochemical reactions between hydrogen and halogens–explosions and hydrogen-oxygen reactions.

UNIT – II FAST REACTION TECHNIQUES, PHOTOCHEMISTRY AND RADIATION CHEMISTRY (18 HOURS)

Introduction– flow methods (continuous and stopped flow methods)– relaxation methods (T and P jump methods) – pulse techniques (pulse radiolysis, flash photolysis)– shock tube method– molecular beam method– lifetime method.

Photophysical processes of electronically excited molecules – Jablonskidiagram Stern-Volmer equation and its applications – experimental techniques in photochemistry– chemical actinometers– lasers and their applications.

Differences between radiation chemistry and photochemistry – sources of high energy radiation and interaction with matter – radiolysis of water, solvated electrons – definition of G value, Curie, linear energy transfer (LET) and Rad –scavenging techniques– use of dosimetry and dosimeters in radiation chemistry–applications of radiation chemistry.

UNIT– III BASIC QUANTUM MECHANICS: (18 HOURS)

Inadequacy of classical mechanics – black body radiation – Planck's quantum concept– photoelectric effect– Bohr's theory of hydrogen atom– hydrogen spectra– wave-particle dualism– uncertainty principle – decline of old quantum theory.

Schrödinger equation – postulates of quantum mechanics – operator algebra: linear operator, Hermitian operators, eigenfunctions and eigenvalues, angular momentum operator– commutation relations and related theorems– orthogonality and normalization.

Applications of wave mechanics to simple systems – particle in a box, one and three dimensional, particle with finite potential barrier– the quantum mechanical tunneling.

UNIT– IV STATISTICALTHERMODYNAMICS: (18 HOURS)

Thermodynamic probability– probability theorems– relation between entropy and probability (Boltzmann-Planck equation), ensembles, phase space, Ergodic hypothesis, microstates and macrostates, Maxwell-Boltzmann distribution law. partition functions– translational, rotational, vibrational and electronic partition functions.

Relationship between partition functions and thermodynamic properties –calculation of equilibrium constants from partition functions– heat capacities of monatomic crystals– Einstein theory and Debye theory.

Quantum statistics – Bose-Einstein (B.E.) and Fermi-Dirac (F.D.) distribution equations – comparison of B.E. and F.D. statistics with Boltzmann statistics –applications of quantum statistics to liquid helium, electrons in metals and Planck's radiation law– concept of negative Kelvin temperature.

UNIT– V GROUPTHEORY AND ITS APPLICATIONS: (18 HOURS)

Symmetry and group theory: Symmetry elements and operations– point groups–assignment of point groups to molecules– group postulates and types of groups–group multiplication tables, sub groups, similarity transformations – conjugate elements and classes.

Matrix representation of symmetry operations and point groups– reducible and irreducible representations– properties of irreducible representation.

The great orthogonality theorem – construction of character table (C_2V & C_3V)–direct product– projection operators– symmetry of hybrid orbitals.

Applications: vibrational spectra – selection rules for fundamental vibrational transition– IR and Raman activity of fundamentals in CO_2, HO,N_2F_2–the rule of mutual exclusion and Fermi resonance.

UNIT– VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Colloids: Distinction between suspension, colloidal solutions and true solutions–lyophilc and lyophobic colloids– Tyndall effect– stability of colloids– coagulation–emulsions – various

types. Micelles: Surfactant (amphipathic molecules) –micellization - critical micelle concentration– size of micelle– aggregation number– Thermodynamics of micellization– reverse micelles.

TOTAL LECTURE HOURS : 90

TEXT BOOK(S)

1. Atkins, P., de Paula, J., & Keeler, J. (2026). *Atkins' physical chemistry* (12th ed.). Oxford University Press.
2. Levine, I. N. (2014). *Physical chemistry* (6th ed.). McGraw-Hill Education.
3. McQuarrie, D. A., & Simon, J. D. (1997). *Physical chemistry: A molecular approach*. University Science Books.
4. Laidler, K. J. (1987). *Chemical kinetics* (3rd ed.). Harper & Row.
5. Cotton, F. A. (1990). *Chemical applications of group theory* (3rd ed.). John Wiley & Sons.

REFERENCE(S)

1. Cotton, F. A. *Chemical Applications of Group Theory*. 3rd Ed., John Wiley and Sons, Singapore, 2026.
2. Flurry, R. L., Jr. *Symmetry Groups: Theory and Chemical Applications*. Prentice Hall, New Jersey, 1980.
3. Kettle, S. F. A. *Symmetry and Structure*. 2nd Ed., John Wiley and Sons, Chichester, 1995.
4. Chandra, A. K. *Introductory Quantum Chemistry*. 4th Ed., Tata McGraw Hill, Noida, 1994.
5. McQuarrie, D. A. *Quantum Chemistry*. University Science Books, Sausalito, 2008.
6. Laidler, K. J. *Chemical Kinetics*. 3rd Ed., Tata McGraw Hill, Noida, 1987.
7. Moore, J. W. and Pearson, R. G. *Kinetics and Mechanism*. 3rd Ed., John Wiley and Sons, New York, 1981.
8. Mortimer, M. and Taylor, P. G. *Chemical Kinetics and Mechanism*. 1st Ed., Royal Society of Chemistry, UK, 2002.
9. Gurtu, J. N. and Gurtu, A. *Advanced Physical Chemistry*. 5th Ed., Pragati Prakashan, Meerut, 2006.
10. Steinfeld, J. I., Francisco, J. S. and Hase, W. L. *Chemical Kinetics and Dynamics*. 2nd Ed., Prentice Hall, New Jersey, 1999.
11. Gupta, K. S. *Chemical Kinetics and Reaction Mechanism*. RBSA Publishers, Jaipur, 1992.
12. Atkins, P. W. *Physical Chemistry*. 7th Ed., Oxford University Press, Oxford, 2001.
13. Rajaram, J. and Kuriacose, J. C. *Thermodynamics for Students of Chemistry: Classical, Statistical and Irreversible*. Pearson Education, New Delhi, 2013.
14. Metiu, Horia. *Physical Chemistry: Thermodynamics*. Taylor and Francis, Singapore, 2006.
15. Rohatgi-Mukherjee, K. K. *Fundamentals of Photochemistry*. 3rd Ed., New Age International Pvt. Ltd., New Delhi, 2014.
16. Spinks, J. W. T. and Woods, R. J. *Introduction to Radiation Chemistry*. 3rd Ed., John Wiley and Sons, New York, 1990.

E-RESOURCES

1. https://ocw.mit.edu
2. https://nptel.ac.in
3. https://chem.libretexts.org
4. www.sciencedirect.com
5. https://link.springer.com
6. https://pubs.acs.org

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	2	2	3	1	1	2	1	1	3	2	1	2	3
CO3	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO4	3	3	2	2	2	1	1	2	1	1	3	2	2	2	2
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
SUNDARAKKOTTAI, MANNARGUDI- 614016
(For the Candidates admitted in the academic year 2026 – 2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: II - CP- II: ORGANIC CHEMISTRY PRACTICAL

Ins. Hrs. /Week: 6 **Course Credit: 4** **Course Code :** P26CH206P

COURSE OBJECTIVES

1. Understand the principles and techniques involved in the qualitative analysis of organic compounds and organic mixtures.
2. Develop skills in the separation, purification, and identification of components present in binary organic mixtures.
3. Perform pilot-scale and bulk-scale separations using appropriate laboratory methods and determine the physical constants of purified compounds.
4. Acquire practical knowledge of functional group analysis and systematic identification of organic substances.
5. Gain proficiency in quantitative estimation techniques for important organic compounds such as phenol, aniline, ketones, and glucose.
6. Apply analytical and experimental methods to determine the identity, purity, and composition of organic compounds.

1.Qualitative analysis of an organic mixture containing two components (Separation followed by analysis of any one component)

Mixtures containing two components are to be separated (pilot separation) and purified (bulk separation)– The physical constants are to be reported (analysis).

2.Quantitative analysis of organic compounds

Estimation of phenol, aniline, ketone and glucose.

COURSE OUTCOMES

The student should able to

1. Create and carryout, work up and separation procedure.
2. Predict the outcomes of organic reactions using a basic understanding of the general reactivity of functional groups and mechanisms.
3. Determine identity, Purity and present yield of products.
4. Understand the concept of crystallization.
5. Understand Quantitative analysis of organic compounds
6. Determine physical constants

TEXT BOOK(S)

1. Gnanaprakasam, N. S., & Ramamurthy, G. (2011). *Organic Chemistry Lab Manual*. S.V. Printers.
2. Vogel's. (2021). *Textbook of Practical Organic Chemistry* (5th ed.). Prentice Hall.
3. Hibbert, D., & Gooding, J. J. (2006). *Data Analysis for Chemistry*. Oxford University Press, UK.
4. March, J., & Smith, M. B. (2019). *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure* (7th ed.). Wiley, New York.
5. March, J. (2017). *Advanced Organic Chemistry: Reaction Mechanisms and Structure*. John Wiley, New York.

REFERENCE(S)

1. Mohan, J. (2014). *Organic Analytical Chemistry: Theory and Practice*. Narosa Publications.
2. Ahluwalia, V. K., Bhagat, P., & Agarwal, R. *Laboratory Techniques in Organic Chemistry*. I. K. International.
3. Vogel, A. I., Tatchell, A. R., Furniss, B. S., Hannaford, A. J., & Smith, P. W. G. *Vogel's Textbook of Practical Organic Chemistry*.
4. Nasipuri, D. (2019). *Stereochemistry of Organic Compounds*. New Age International Private Limited, New Delhi.
5. Clayden, J., Greeves, N., & Warren, S. (2000). *Organic Chemistry*. Oxford University Press, USA.

E–RESOURCES

1. www.toppr.com/guides/chemistry/organic-chemistry/quantitative-analysis/
2. https://ncert.nic.in/textbook/pdf/kech205.pdf
3. wwwchem.uwimona.edu.jm/lab_manuals/c10expt25.html
4. https://chem.libretexts.org
5. www.orgsyn.org

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	2	2	3	1	1	2	1	1	3	2	1	2	3
CO3	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO4	3	3	2	2	2	1	1	2	1	1	3	2	2	2	2
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
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(For the Candidates admitted in the academic year 2026-2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: II DCEC - IIA: MOLECULAR SPECTROSCOPY

Ins. Hrs. /Week: 5 **Course Credit: 4** **Course Code:**P26CHDE22A

COURSE OBJECTIVES

- Understand the fundamental principles of rotational, vibrational, Raman, electronic, NMR, mass, and EPR spectroscopic techniques and their theoretical foundations.
- Interpret rotational and vibrational spectra of diatomic and polyatomic molecules,
- Analyze electronic transitions, photoelectron spectra, laser action, and molecular energy levels to explain the spectroscopic behavior of atoms and molecules.
- Apply NMR spectroscopy for structural elucidation by interpreting chemical shifts, spin–spin coupling, NOE effects,
- Utilize mass spectrometry and EPR spectroscopy to identify molecular structures, fragmentation pathways,

UNIT-I: ROTATIONAL AND RAMAN SPECTROSCOPY: (15 HOURS)

Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.

UNIT-II: VIBRATIONAL SPECTROSCOPY: (15 HOURS)

Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.

UNIT-III: ELECTRONIC SPECTROSCOPY: (15 HOURS)

Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, Xray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems.

UNIT-IV: NMR SPECTROSCOPY: (15 HOURS)

Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX2, AB types. Vicinal, germinal and long-range coupling-spin decoupling. Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. 13CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR. ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons) including biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples.

UNIT-V: MASS SPECTROMETRY AND EPR SPECTROSCOPY: (15 HOURS)

Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum. EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Zero-field splitting (ZFS) and Kramer's degeneracy. Applications of EPR to organic and inorganic systems. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.

UNIT VI : Current Contours (For Continuous Internal Assessment Only – Self Study)

Spectroscopic characterization of organic, inorganic and coordination compounds. Applications in environmental monitoring, forensic science and medicinal chemistry. Spectroscopy in nanotechnology and material science. Recent developments in hyphenated and multidimensional spectroscopic techniques.Get smarter responses, upload files and images, and more.

.TOTAL LECTURE HOURS: 75

COURSE OUTCOMES

Students will be able:

1. To understand the importance of rotational and Raman spectroscopy.
2. To apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules.
3. To evaluate different electronic spectra of simple molecules using electronic spectroscopy.
4. To outline the NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, Introduction to ^{31}P, ^{19}FNMRand ESR spectroscopic techniques.

5. To develop the knowledge on principle, instrumentation and structural elucidation of simplemolecules
6. Apply Mass Spectrometry, EPR and Mossbauer Spectroscopy techniques.

TEXT BOOK(S)

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., TataMcGraw Hill, New Delhi, 2000.
2. R. M. Silverstein and F. X. Webster, Spectroscopic Identification of Organic Compounds, 6thEd., John Wiley & Sons, New York, 2026
3. W. Kemp, Applications of Spectroscopy, English Language Book Society, 1987.
4. D. H. Williams and I. Fleming, Spectroscopic Methods in OrganicChemistry, 4th Ed., TataMcGraw-Hill Publishing Company, New Delhi, 1988.
5. R. S. Drago, Physical Methods in Chemistry; Saunders: Philadelphia, 1992.

REFERENCE BOOK(S)

1. Atkins, P. W., & de Paula, J. (2002). Physical Chemistry (7th ed.). Oxford University Press, Oxford.
2. Levine, I. N. (1974). Molecular Spectroscopy. John Wiley & Sons, New York.
3. Rahman, A. (1986). Nuclear Magnetic Resonance: Basic Principles. Springer-Verlag, New York.
4. Nakamoto, K. (1997). Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part B (5th ed.). John Wiley & Sons Inc., New York.
5. Weil, J. A., Bolton, J. R., & Wertz, J. E. (1994). Electron Paramagnetic Resonance. Wiley-Interscience.
6. Griffiths, P. R., & de Haseth, J. A. (2023). Fourier Transform Infrared Spectrometry (2nd ed.). Wiley-Interscience.
7. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2026). Principles of Instrumental Analysis (7th ed.). Cengage Learning.

E RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
2. www.digimat.in/nptel/courses/video/104106122/L14.html
3. https://courses.lumenlearning.com/suny-mcc- organicchemistry/chapter/the-general-mechanism-for-electrophilic-aromatic-substitution-reactions/
4. www.academia.edu/38161284/natural_product_total_synthesis
5. www.learn.mit.edu/c/unit/ocw?resource=8180

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	2	2	3	1	1	2	1	1	3	2	1	2	3
CO3	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO4	3	3	2	2	2	1	1	2	1	1	3	2	2	2	2
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

Semester: II DCEC-II B BIOINORGANIC AND ORGANOMETALLIC CHEMISTRY

Ins. Hrs. /Week: 4 **Course Credit: 4** **Course code:** P26CHDE22B

COURSE OBJECTIVES

- To understand the biological significance of metal ions and their role in living systems.
- To study the structure, properties and functions of metalloproteins and metalloenzymes.
- To gain knowledge of metal-based drugs and their medicinal applications.
- To understand the bonding, structure and reactivity of organometallic compounds.
- To study important organometallic reaction mechanisms and catalytic processes.
- To explore the industrial, biological and synthetic applications of organometallic compounds.

UNIT I: INTRODUCTION TO BIOINORGANIC CHEMISTRY (12 HOURS)

Essential and trace elements in biological systems. Classification and distribution of biologically important elements. Biological functions of alkali and alkaline earth metal ions. Role of sodium, potassium, magnesium and calcium ions in physiological processes. Ion transport across biological membranes. Sodium-potassium pump and calcium signaling. Bioenergetics and ATP. Metal ions in biological electron transfer and energy conversion. Toxicity of metal ions, heavy metal poisoning and detoxification. Chelation therapy and its applications.

UNIT II: METALLOPROTEINS AND METALLOENZYMES (12 HOURS)

Metalloproteins – structure and biological significance. Hemoglobin and myoglobin: structure, oxygen binding and transport. Cytochromes and electron transport proteins. Iron-sulfur proteins and ferredoxins. Biological oxidation-reduction processes. Metalloenzymes – carbonic anhydrase, carboxypeptidase and superoxide dismutase. Zinc-containing enzymes and their catalytic functions. Vitamin B12 and coenzyme functions. Nitrogenase and biological nitrogen fixation. Role of molybdenum and iron in enzymatic reactions.

UNIT III: METAL-BASED DRUGS AND MEDICINAL BIOINORGANIC CHEMISTRY (12 HOURS)

Principles of medicinal inorganic chemistry. Essential metals in medicine. Metal complexes as therapeutic and diagnostic agents. Platinum-based anticancer drugs – cisplatin, carboplatin and oxaliplatin. Mechanism of anticancer action. Gold, silver and bismuth compounds in medicine. Lithium compounds and their therapeutic applications. Radiopharmaceuticals and their uses. MRI contrast agents. Toxicological aspects of metal-based drugs.

UNIT IV: INTRODUCTION TO ORGANOMETALLIC CHEMISTRY (12 HOURS)

Definition, classification and characteristics of organometallic compounds. Effective Atomic Number (EAN) rule and 18-electron rule. Nomenclature of organometallic compounds. Nature of metal-carbon bond. Metal carbonyls – preparation, properties and bonding. Synergic bonding and back donation. Structure and bonding of mononuclear and polynuclear carbonyls. Carbonylate anions. Organometallic compounds of lithium, magnesium and aluminium. Grignard reagents – preparation, properties and synthetic applications.

UNIT V: ORGANOMETALLIC REACTIONS AND CATALYSIS (12 HOURS)

Ligand substitution reactions in organometallic compounds. Oxidative addition and reductive elimination reactions. Migratory insertion and β-hydride elimination reactions. Fluxional organometallic compounds. Homogeneous catalysis and catalytic cycles. Wilkinson's catalyst and catalytic hydrogenation. Hydroformylation process. Zeise's salt and ferrocene. Industrial applications of organometallic compounds. Organometallic reagents in organic synthesis. Introduction to bioorganometallic chemistry and recent developments.

UNIT VI: Current Contours (For Continuous Internal Assessment Only – Self Study)

Biological importance of transition metal complexes. Metal ions in environmental systems. Organometallic compounds in pharmaceuticals and agriculture. Applications in industrial catalysis and polymerization processes. Bioorganometallic compounds and medicinal applications. Metal complexes in diagnostics and imaging. Organometallic compounds in nanotechnology and materials science. Recent advances in bioinorganic and organometallic chemistry.

TOTAL LECTURE HOURS: 60

COURSE OUTCOMES

Students will be able to:

1. Understand the biological roles of essential and trace metal ions in living systems.
2. Explain the structure and functions of metalloproteins and metalloenzymes.
3. Evaluate the medicinal applications of metal-based drugs and diagnostic agents.
4. Describe the bonding, structure and properties of organometallic compounds.
5. Analyze important organometallic reaction mechanisms and catalytic processes.
6. Apply bioinorganic and organometallic principles in biological, industrial and medicinal fields.

TEXT BOOK(S)

1. Bertini, I., Gray, H. B., Stiefel, E. I. and Valentine, J. S., Biological Inorganic Chemistry: Structure and Reactivity, University Science Books, 2007.
2. Kaim, W. and Schwederski, B., Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, Wiley, 2013.
3. Gupta, B. D. and Elias, A. J., Basic Organometallic Chemistry, Universities Press, 2013.
4. Crabtree, R. H., The Organometallic Chemistry of the Transition Metals, 7th Edition, Wiley, 2026.
5. Huheey, J. E., Keiter, E. A. and Keiter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education.

REFERENCE(S)

1 Cotton, F. A., Wilkinson, G., Murillo, C. A., & Bochmann, M. (1999). Advanced inorganic chemistry (6th ed.). Wiley.

2. Greenwood, N. N., & Earnshaw, A. (1997). Chemistry of the elements (2nd ed.). Butterworth-Heinemann.

3 Lippard, S. J., & Berg, J. M. (1994). Principles of bioinorganic chemistry. University Science Books.

4 Elschenbroich, C. (2006). Organometallics (3rd ed.). Wiley-VCH.

5 Spessard, G. O., & Miessler, G. L. (2010). Organometallic chemistry (2nd ed.). Oxford V University Press.

6. Shriver, D. F., Atkins, P. W., Overton, T. L., Rourke, J. P., Weller, M. T., & Armstrong, F. A. (2026). Shriver and Atkins' inorganic chemistry (6th ed.). Oxford University Press.

E-RESOURCES

1. https://nptel.ac.in/courses
2. https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry
3. http://chem.libretexts.org/Bookshelves/Inorganic_Chemistry
4. ChemLibreTexts – Bioinorganic Chemistry
5. www.chem.libretexts.org

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2	1	1	2	1	1	3	1	1	2	2
CO2	3	3	2	2	3	1	1	2	1	1	3	2	1	2	3
CO3	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO4	3	3	2	2	2	1	1	2	1	1	3	2	2	2	2
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

Semester: II DCEC – IIC - Inorganic Photochemistry

Ins. Hrs. /Week: 4 **Course Credit: 4** **Course code:** P26CHDE22C

COURSE OBJECTIVES

- Understand the fundamental principles of photochemistry,and photochemical laws governing coordination compounds.
- Explain the photophysical and photochemical properties of transition metal complexes,
- Analyze charge transfer photochemistry in metal complexes, including charge transfer absorption spectra,
- Interpret ligand field photochemistry of transition metal complexes,
- Evaluate photochemical reactions occurring on solid surfaces and semiconductor materials,

UNIT I PRINCIPLES OF PHOTOCHEMISTRY (12 HOURS)

Absorption, excitation, photochemical laws, quantum yield. Absorption and emission for complexes with different ground state /excited state for ML6complexes.Potential energy function and energy levels for ML6complexes.Flash photolysis, stopped flow techniques. Energy dissipation by radiative and non-radiative processes, absorption spectra. Frank-Codon principle, photochemical stages – primary and secondary processes. Jablonski diagram for photochemical process

UNIT II PHOTOCHEMICAL PROPERTIES OF TRANSITION METAL COMPLEXES (12 HOURS)

Photo physical process, Photochemical process, Photo substitution reactions, photoredox reactions, Photorearrangement reaction, Prompt and Delayed Photochemical reactions, Photolysis rules and ligand field theory

UNIT III CHARGE TRANSFER PHOTOCHEMISTRY (12 HOURS)

Introduction, charge transfer absorption spectra, types of charge transfer excitations and their energy level scheme for charge transfer excitations, Types of reactions observed by charge transfer metal complexes.

UNIT IV LIGAND FIELD PHOTOCHEMISTRY OF TRANSITION METALCOMPLEXES (12 HOURS)

Photochemistry Cr(III) of complexes : Photo-substitutions, properties of ligand field excited states, Photoaquation reactions, photolysis rule , photoisomerization , photo racemization, photoanation reactions, sensitizer, energy transfer process, Mechanism of photosensitization, photo reactive excited state. The Doublet hypothesis, Role of quartet excited states, Photochemistry of Co(III) complexes : Introduction, energy level diagram, Photoaquations in Co(III) amine, Co(III) cyanide complexes, Fe(II) low spin complexes, Ru(II) ammine derivative complexes, Photo redox properties of Ce(III)and Ce(IV) complexes, photochemistry of Cu(II) (1,3 diketone) complexes.

UNIT V PHOTOCHEMICAL REACTIONS ON SOLID SURFACE (12 HOURS)

Introduction, photo electron transfer mechanism, energy level diagram of solid acceptor and donor levels, Examples of photo catalytic metal/mixed metal oxides and their applications, semiconductor supported metal oxides for photolysis of water, Decomposition of organic pollutants, experimental setup, end product of organic products, carbon dioxide reduction, nitrogen fixations, solar energy conversion and its storage. Chemiluminescence's in coordination complexes, Thexi state and Franck condon state

UNIT – VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Occurrence, nomenclature and general methods of structure determination of Anthocyanidins.Synthesis of Cyanidin Chloride, Chalcones, Flavones, Quercetin.Occurrence, classification.Biogenesis, physiological effects and synthesis of PGE2 and PGF2z. Natural and synthetic of pyrethroids, Rotenones and pheromones.Synthesis of bombykol.

Total Lecture Hours: 60

COURSE OUTCOMES

1. Understand, concepts of Bioinorganic Chemistry, Function and Transport of Alkali and Alkaline earth metals,
2. Introduce the principles of bioinorganic chemistry and advanced Transition Metal Complexes
3. knowledge in Inorganic Chemistry and Coordination Chemistry.
4. Draw the energy level diagram in Transition Metal Complexes.
5. Analyse decomposition of organic pollutants.
6. Examples of photo catalytic metal/mixed metal oxides and their applications.

TEXT BOOKS

1.Lippard, S. J., and Berg, J. M.,2018. Principles of Bioinorganic Chemistry, Panima Publishing Company, New Delhi,

2. Kaim W., and Schewederski, B., 2026 Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John Wiley & Sons, New York, USA,.

3.Bertini, I., Gray, H. B., Lippard, S. J. and Valentine, J. S., 2007 Bioinorganic Chemistry, 1 st South Asia edition, Viva books Pvt. Ltd.,.

4. Huheey, J. E., Keiter, E. A. and Keiter, R. L., and Medhi, O. K., 2006. Inorganic Chemistry - Principles of Structure and Reactivity,4th edition, Pearson Education,

5. Behrens, P., Bauerlein, E., 2007. Hand Book of Biomineralization, 1st edition, Vol. 1& 2, Wiley-VCH.

REFERENCE BOOKS

1. Purcell, K. F. and Kotz, J. C., 2012. Inorganic Chemistry, Cengage Learning,

2. Cotton, F. A., Wilkinson, G., Carlos A. Murillo, 2007Manfred Bochmann, Advanced Inorganic Chemistry, 6th ed., A Wiley - Interscience Publication, John –Wiley & Sons, USA,.

3. Atkins, P., Overton, T., Rourke, J., Weller M., and Armstrong, F., , 2010. Inorganic Chemistry, 5th edition, Oxford University Press.

4. Lehninger, A., Nelson, D. L., Cox, M. M, 2008. Principles of Biochemistry, 5th edition, W.H Freeman,

5. Alessio, E., 2026. Bioinorganic Medicinal Chemistry, 1st Edition, Wiley-VCH Verlag GmbH Co. KGaA,

E-RESOURCES

1.https://cds.cern.ch/record/1254287/files/9780470014936_TOC.pdf

2.http://photobiology.info/Photochem.html

3.https://www.wiley.com

4.www.patents.google.com/patent/EP3207992A1/en

5.www.eurekaselect.com/170683/article

MAPPING WITH PROGRAM OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2	1	1	2	1	1	3	2	1	2	2
CO2	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO3	3	3	3	3	3	1	1	2	1	2	3	3	3	3	3
CO4	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	3	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
SUNDARAKKOTTAI, MANNARGUDI- 614016
(For the Candidates admitted in the academic year 2026-2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: II - GEC-IIA : Green Chemistry

Ins. Hrs. /Week:4 **Course Credit: 3** **Course Code: P26CHGE22A**

COURSE OBJECTIVES

- To learn the green chemistry and their principles.
- To learn the importance of greener reactions.
- To understand the phase-transfer catalyst in green chemistry.
- To learn Oxidation reactions
- To learn waste management and sustainable development.

UNIT -I : Principles and Green Chemistry Synthesis (12 HOURS)
Green chemistry - relevance and goals, Anastas‟ twelve principles of green chemistry - Tools ofgreen chemistry: alternative starting materials, reagents, catalysts, solvents and processes withsuitable examples.

UNIT -II : Addition And Condensation Reactions (12 HOURS)
Addition reactions – Michael addition in [aqueous medium and solid state] – Diels Alder reactions, in aqueous phase. Condensation reactions – Aldol condensation of aldehydes with nitroalkanes and nitriles, Knoevengal condensations–Wittig reactions– Aldol condensation in solid phase – benzoin condensation under catalytic conditions – applications.

UNIT- III : Oxidation And Reduction Reactions (12 HOURS)
Oxidation reactions – Baeyer-Villiger oxidation in aqueous phase and solid state – enzymatic Baeyer-Villiger oxidation-Reduction reactions – Clemmensen reduction – mechanism – multi-component reactions, limitations – applications.

UNIT -IV : Phase-Transfer Catalyst Reactions (12 HOURS)
Heck reaction – Michael addition reaction – oxidation of toluene to benzoic acid – Reimer-Tiemann reaction – Baker-Venkataraman synthesis – Williamson ether synthesis – Dozen reaction.-Baker‟s yeast mediated bio-transformations–Bio-catalyst mediated Baeyer-Villigerreactions Microbial polyester synthesis.

UNIT - V : Sono Chemistry (12 HOURS)
Barbieri reaction – Reformat sky reaction – Simmons-Smith reaction – Strecker synthesis –Ullmann coupling reaction – Wurtz reaction – Bouveault reaction.

UNIT – VI : Current Contours (For Continuous Internal Assessment Only – Self Study)
Industrial applications of green chemistry – green synthesis of pharmaceuticals and polymers. Microwave assisted organic synthesis – advantages and applications. Ionic liquids and supercritical fluids as green solvents. Atom economy and E-factor concept. Green chemistry approaches in pollution prevention, waste management and sustainable development.

Total Lecture Hours: 60

COURSE OUTCOMES

Students will able to

1. Understand the 12 principles of green chemistry.
2. Understand the various addition and condensation reactions involved ingreen Chemistry.
3. Understand the various Oxidation and reduction reactions involved in greenChemistry
4. Learn the mechanism of Phase transfer catalysed reactions
5. Understand the significance of Sonication reactions.
6. Industrial applications of green chemistry.

TEXT BOOK(S)

1. AnjuGiyal . 2014. Green chemistry. a new approach towards science, vol. I, discoverychemistry.
2. Mary M Kirchhoff, 2026. Green chemistry – Principles and practice, American chemicalsociety.
3. Mike Lancaster. 2010. Green Chemistry – an introductory text, 2nd Edition, Royal Societyof Chemistry publishers,
4. Syed AftabIqbal . 2016. Textbook of green chemistry, Discovery Publishing Pvt.Ltd.
5. Albert Matlack. 2010. Introduction to Green Chemistry, CRC Press, Newyork, London.

REFERENCE BOOK(S)

1. Ahluwalia. V. K . 2016. Green Chemistry. 2nd Edition. Ane Books Pvt Ltd. New Delhi.
2. Ahluwalia. V.K and Agarwal . K. 2007. Organic Synthesis, Special Techniques. 2ndEdition. Narosa Publishing House, New Delhi.
3. Anastas .P .T and Warner . J . C 2005. Green chemistry Theory and Practice. OxfordUniversity Press, New York.
4. Kumar .V. 2026. An introduction to Green Chemistry, Vishal publishing Co.
5. Suresh .C. Ameta RakshitAmeta Garima Ameta 2018, Sonochemistry. An EmergingGreen Technology, Apple academic press, Kindle Edition.

E- RESOURCES:

1.https://application.wiley-vch.de/books/sample/3527324186_c01.pdf
2.https://chem.pg.edu.pl/documents/614792/2c6c0579-c52b-400e-a396-07a03363f4e0
3. www.chemguide.co.uk
4.www.organicchemistrydata.org
5. www.masterorganicchemistry.com

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2	1	1	2	1	1	3	2	1	2	2
CO2	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO3	3	3	3	3	3	1	1	2	1	2	3	3	3	3	3
CO4	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	3	2	3	3	3	3	3	3

Strong - 3

Medium-2 **Low-1**

Semester: II - GEC – I1B : Supramolecular Chemistry

Ins. Hrs. /Week: 4 **Course Credit: 3** **Course Code:** P26CHGE22B

OBJECTIVES

- To know the fundamentals of supramolecules.
- To learn co-receptor molecules and multiple recognition
- To study the supramolecular reactivity and catalysis
- To understand supramolecular reactivity, catalysis, and the role of non-covalent interactions in chemical transformations.
- To explore the applications of supramolecular chemistry in materials science, biological systems, sensing, and nanotechnology.

UNIT– I CONCEPTS OF SUPRAMOLECULAR CHEMISTRY (15 HOURS)

Concepts and languages of supramolecular chemistry – various types of non-covalent interactions– hydrogen bonds, C-H···X interactions, halogen bonds– π-πinteractions, non–bonded interactions– various types of molecular recognition.

Crystal engineering of organic solids– hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions– principles of crystal engineering and non-covalent synthesis – polymorphism and pseudopolymorphism–supramolecular isomorphism / polymorphism – crystal engineering of pharmaceutical phases.

UNIT– II METALLO ORGANIC FRAMEWORKS (15 HOURS)

M.O.F (Metallo Organic Frameworks)– organometallic systems– combinations of different interactions to design molecular rods, triangles, ladders, networks, etc.–design of nanoporous solids– interligand hydrogen bonds in metal complexes–implications for drug design– crystal engineering of NLO materials, OLED.

UNIT– III CO-RECEPTOR MOLECULES AND MULTIPLE RECOGNITION

(15 HOURS)

Dinuclear and polynuclear metal ion cryptates– linear recognition of molecular length by ditopic co-receptors– heterotopic co-receptors– cyclophane receptors, amphiphilic receptors and large molecular cages – multiple recognition in metalloreceptors– supramolecular dynamics.

UNIT – IV SUPRAMOLECULAR REACTIVITY AND CATALYSIS

(15 HOURS)

Catalysis by reactive macrocycliccation receptor molecules– catalysis by reactive anion receptor molecules – catalysis with cyclophane type receptors – supramolecularmetallocatalysis– cocatalysis– catalysis of synthetic reactions –biomolecular and abiotic catalysis.

Supramolecular chemistry in solution – cyclodextrin, micelles, dendrimers, gelators– classification and typical reactions– applications.

UNIT – V SUPRAMOLECULAR DEVICES:

Supramolecular devices and sensors– various types of supramolecular devices–an overview – supramolecular photochemistry – molecular and supramolecularphotonic devices– light conversion and energy transfer devices–molecular and supramolecular electronic devices– electronic conducting devices– molecular wires, modified and switchable molecular wires – molecular and supramolecular ionic devices – tubular mesophases, molecular protonics–switching devices – electro-photo switch – ion and molecule sensors – role of supramolecular chemistry in the development of nanoscience and technology.

UNIT – VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Ionophores, Porphyrin and other TetrapyrrolicMacrocycles, Coenzymes, Neurotransmitters, DNA and Biochemical Self-assembly.SupramolecularreactivityBiomimetic systems and Artificial receptors:

(a) Cation Binding Hosts - Podand, Crown Ether, Cryptand, Spherand; Nomenclature, Selectivity and Solution Behaviour; Alkalides, Electrides, Calixarenes and Siderophores.
(b) Anion binding hosts - Challenges and Concepts, Biological Receptors, Conversion of Cation Hosts to Anion Hosts, Neutral Receptors, Metal-Containing Receptors, Cholapods.
(c) Ion Pair Receptors - Contact Ion Pairs, Cascade Complexes, Remote Anion and Cation Binding Sites, Symport and Metals Extraction.
(d) Hosts for Neutral Receptors -Clathrates, Inclusion Compounds, Zeolites, Intercalates, Coordination Polymers, Guest Binding by Cavitands and Cyclodextrins, cucurbituril.

COURSE OUTCOMES

Students will be able to:

1. Understand the fundamental concepts, principles, and significance of supramolecular chemistry and molecular recognition.
2. Explain the nature of non-covalent interactions such as hydrogen bonding, π–π interactions, van der Waals forces, hydrophobic interactions, and electrostatic forces in supramolecular systems.

3. Analyze host–guest chemistry involving crown ethers, cryptands, cyclodextrins, calixarenes, and cucurbiturils.
4. Evaluate the mechanisms of self-assembly, molecular machines, and supramolecular architectures.
5. Apply supramolecular chemistry concepts to catalysis, sensing, drug delivery, and nanotechnology.
6. Assess recent advances and emerging applications of supramolecular chemistry in materials science, biological systems, and environmental remediation.

TEXT BOOK(S)

1. Steed, J. W. and Atwood, J. L., *Supramolecular Chemistry*, 3rd Edition, Wiley, 2022.
2. Lehn, J. M., *Supramolecular Chemistry: Concepts and Perspectives*, Wiley-VCH, 1995.
3. Schneider, H. J. and Yatsimirsky, A. K., *Principles and Methods in Supramolecular Chemistry*, John Wiley & Sons, 2000.
4. Beer, P. D., Gale, P. A. and Smith, D. K., *Supramolecular Chemistry*, Oxford University Press, 1999.
5. Balzani, V., Credi, A. and Venturi, M., *Molecular Devices and Machines: Concepts and Perspectives for the Nanoworld*, Wiley-VCH, 2008.

REFERENCE(S)

1. J. M. Lehn, Supramolecular Chemistry; VCH, Weinheim, Germany, 1995.
2. G. R. Desiraju, Crystal Engineering: The Design of Organic Solids; Elsevier, United States, 1989.
3. G. R. Desiraju, and T. Steiner, The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press, Oxford, 1999.
4. G. A Jeffrey, Introduction to Hydrogen Bonding; Oxford University Press: UK, 1997.
5. J. M. Lehn, Transition Metals in Supramolecular Chemistry; John Wiley and Sons: New York, 1999.

E-RESOURCES

1. NPTEL – Supramolecular Chemistry Courses
2. MIT OpenCourseWare – Chemistry Resources
3. ChemLibreTexts – Supramolecular Chemistry
4. Royal Society of Chemistry Learning Resources
5. International Union of Pure and Applied Chemistry (IUPAC)
6. American Chemical Society Publications
7. Nature Chemistry
8. ScienceDirect – Supramolecular Chemistry Collection

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2	1	1	2	1	1	3	2	1	2	2
CO2	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO3	3	3	3	3	3	1	1	2	1	2	3	3	3	3	3
CO4	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	3	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
SUNDARAKKOTTAI, MANNARGUDI- 614016
(For the Candidates admitted in the academic year 2026-2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: I - GEC – 1IC : Solid State Chemistry

Ins. Hrs. /Week: 4 **Course Credit: 3** **Course Code:** P26CHGE22C

COURSE OBJECTIVES:
- To learn the band theory and defects of solids.
- To study the preparative methods and solid state reactions.
- To learn the applications of thermal and magnetic materials.
- To learn the Lasers and phosphors
- To learn Organic solidstate chemistry

UNIT I: CRYSTAL STRUCTURE AND CRYSTAL ENGINEERING OF ORGANIC SOLIDS (12 HOURS)

Types of close packing – hcp and ccp – packing efficiency – SC, BCC, and FCC, radius ratio rule – applications – polyhedral description of solids – structure types: Na_2O, Cs_2O, rutile, perovskite (ABO_3), ReO_3, K_2NiF_4, spinels and antispinels. Hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudopolymorphism – supramolecular isomorphism, polymorphism and crystal engineering of pharmaceutical phases.

UNIT II: METALLO ORGANIC FRAMEWORKS (12 HOURS)

M.O.Fs (Metallo Organic Frameworks) – organometallic systems – combinations of different interactions to design molecular rods, triangles, ladders, networks, etc. Design of nanoporous solids. Interligand hydrogen bonds in metal complexes – implications for drug design – crystal engineering of NLO and OLED materials.

UNIT III: PREPARATIVE METHODS IN SOLID STATE CHEMISTRY (12 HOURS)

Experimental procedure, coprecipitation as a precursor to solid state reaction, other precursor methods, kinetics of solid state reactions – crystallizations of solutions, melts, glasses and gels, solutions and gels: zeolite synthesis – precipitation from solution or melt: flux method, epitaxial growth of thin layers, verneuil flame fusion method. Graphite intercalation compounds, transition metal

dichalcogenide and other intercalation compounds, ion exchange reaction, synthesis of new metastable phases by 'Chimie Douce'. Electrochemical reduction methods – preparation of thin films, chemical and electrochemical methods, physical methods – growth of single crystals, Czochralski method, Bridgman-Stockbarger methods – zone melting. Vapour phase transport, hydrothermal methods, comparison of different methods – high pressure and hydrothermal methods and dry high pressure methods.

UNIT IV: MAGNETIC MATERIALS AND OPTICAL PROPERTIES (12 HOURS)

Selected examples of magnetic materials and their properties – metals and alloys, transition metal oxides, spinels, garnets, ilmenite and perovskites. Magnetoplumbites – applications – structure/property relations – transformer,information storage, magnetic bubble memory devices, permanent magnets. Luminescence, Lasers and phosphors – definitions and general comments, configurational coordinate model, some phosphor materials, anti-Stokes phosphors –lasers – the ruby laser, Neodymium lasers

UNIT V: ORGANIC SOLIDSTATE CHEMISTRY (12 HOURS)

Topochemical control of solid state organic reactions – intramolecular reactions – conformational effects – intermolecular reactions – molecular packing effects – photodimerization of 2-ethoxycinnamic acid (α form, β form, γ form) – photopolymerization of 2,5-distyrylpyrazine – photopolymerizations of diacetylenes. Asymmetric syntheses – dimerization of anthracene – control of molecular packing arrangements. Organic reactions within inorganic host structures – electrically conductive organic solids – organic metals, conjugated systems, doped polyacetylene, polyparaphenylene, polypyrrole – organic charge transfer complexes – new superconductors.

UNIT – VI CRYSTAL ENGINEERING OF ORGANIC SOLIDS (Continuous Internal Assessment Only - Self study)

: Hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudopolymorphism – supramolecular isomorphism, polymorphism and crystal engineering of pharmaceutical phases.

Total Lecture Hours: 60

COURSE OUTCOMES

The student should able to

1. Identify crystal structures of few inorganic solids.
2. Study the chemistry of crystallization and vapour phase transport.
3. Explain the applications of magnetic materials.
4. Understand the chemistry of organic solids.

5. Design the molecular rods, triangles, ladders, networks

6. Explain polymorphism and pseudopolymorphism.

TEXT BOOK(S)

1. J. D. Lee (2011). *Concise Inorganic Chemistry*, 5th ed., Blackwell Science, London.

2.D. F. Shriver and P. W. Atkins (2021). *Inorganic Chemistry*, 3rd ed., W. H. Freeman and Co., New York.

3.B. R. Puri, L. R. Sharma, and K. C. Kalia (2019). *Principles of Inorganic Chemistry*, Shoban Lal Nagin Chand & Co., Delhi.

4. J. M. Lehn (2022). *Transition Metals in Supramolecular Chemistry*, Vol. 5, John Wiley & Sons, New York.

5. C. N. R. Rao (2001). *Current Science*, Royal Society of Chemistry, UK.

REFERENCE(S)

1.A. R. West,2019. Solid State Chemistry and Its Applications; 2nd Ed., John Wiley and sons, New York,

2.J. M. Lehn, 2011.Supramolecular Chemistry; VCH, Weinheim,.

3.G. R. Desiraju,2026. Crystal Engineering: The Design of Organic Solids; Elsevier, Amsterdam,

4.G. R. Desiraju, and T. Steiner, 2002 The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press: Oxford,.

5.G. A. Jeffrey, 1997 Introduction to Hydrogen Bonding; Oxford University Press, New York,.

E-RESOURCE(S)

1.https://link.springer.com/chapter

2.https://books.google.com/books/about/Crystal_Engineering

3.www.researchgate.net

4.https://engineering.virginia.edu/departments/materials-science-and-engineering/research/electrical- optical-properties

5.www.nanowerk.com/mof-metal-organic-framework.php

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2	1	1	2	1	1	3	2	1	2	2
CO2	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO3	3	3	3	3	3	1	1	2	1	2	3	3	3	3	3
CO4	3	3	2	3	3	1	1	2	1	2	3	3	2	3	3
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	3	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
SUNDARAKKOTTAI, MANNARGUDI- 614016
(For the Candidates admitted in the academic year 2026 – 2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: II SEC - IIC: Sustainable Water Resources Management

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Ins. Hrs. /Week :2 **Course Credit: 3** **Course Code:** P26SECH22

COURSE OBJECTIVES:

• To understand the fundamental concepts of water resources, their distribution, availability, and importance for sustainable development.
• To acquire knowledge of water quality assessment, water pollution sources, and strategies for water conservation and management.
• To understand the principles and practices of integrated water resource management for sustainable utilization of water resources.
• To examine the impact of climate change, population growth, and industrialization on water resources and water security.
• To develop awareness of modern technologies, policies, and sustainable approaches for water treatment, recycling, and efficient water management.

UNIT I **(6 HOURS)**
Water resources survey – Water resources of India andTamilnadu – Description of water resources planning –National Water Policy- Properties of water - Water quality standards-WHO& APHA Standards.

UNIT II **(6 HOURS)**
Water resources development - Scope and aims of master plan for irrigation tanks–Farm ponds and percolation ponds –Rain water harvesting.

UNIT III **(6 HOURS)**
Watershed – Concept – Classification – Characteristics – Watershed Programmes –Watershed Management Practices.

UNIT IV
Occurrence of Ground water –Utilization of Ground water- Aquifer and its types –Ground water recharge- Ground water status atState and National level.

UNIT V **(6 HOURS)**
Sample Collection-Processing Preservations –Testing Kit -Determination of
pH- Acidity and Alkalinity – Turbidity - Total Solids- Total volatile solids-Total suspended solids-Water level indicator at different location demonstration- Safety precautions in the Laboratory.

UNIT VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Irrigation methods, distribution systems, and water resources Role of agricultural water management from field to district level Blue-Green-Water-Concept, Virtual Water Surface water reservoir management & groundwater calculations

Total Lecture Hours: 30

Course Outcomes

At the end students can

1. Understand the importance of Water resources
2. Understand the importance of Water resources Development
3. Understand the concept of Watershed practices.
4. Understand the Occurrence of Ground water
5. Experimental practice according to the present water issues.

TEXTBOOK(S)

1. Suresh, R. (1982). *Soil and water conservation*. Standard Publication.
2. Duggal, K. N. (2024). *Elements of environmental engineering*. S. Chand & Co. Ltd.
3. Raghunath, H. M. (1987). *Groundwater* (2nd ed.). Wiley Eastern Ltd.
4. Garg, S. K. (2017). *Textbook of environmental engineering* (Vol. 2). Khanna Publishers.
5. Kandpal, V., & Choudhury, T. (Eds.). (2026). *Blue revolution: Sustainable water use and circular economy innovations*. Springer Nature.

REFERENCES .

1. Central Public Health and Environmental Engineering Organisation (CPHEEO). (2013). *Manual on sewerage and sewage treatment systems (Part A, B & C)*. Ministry of Urban Development, Government of India.
2. Trivedi, R. K. (Ed.). (n.d.). *Handbook of environmental laws, rules, guidelines, compliances and standards* (Vol. 1–2). Enviro Media.
3. Cunningham, W. P., Cooper, T. H., & Gorhani, E. (2026). *Environmental encyclopedia*. Jaico Publications.
4. Sengar, D. S. (2007). *Environmental law*. Prentice Hall of India.
5. Rajagopalan, R. (2005). *Environmental studies: From crisis to cure*. Oxford University Press.

E- RESOURCES:

1.https://byjus.com/biology/biodiversity-conservation
2. https://www.vedantu.com/biology/conservation-of-biodiversity
3. https://www.conserve-energy-future.com/waste-management-and-waste-disposal- methods.php
4.www.byjus.com/biology/biodiversity-conservation
5.www.vedantu.com/biology/conservation-of-biodiversity
6.www.conserve-energy-future.com/waste-management-and-waste-disposal-methods.php

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	1	2	3	2	1	1	3	1	1	3	2
CO2	3	2	1	1	2	1	3	2	1	2	3	1	1	3	2
CO3	3	3	2	1	2	1	3	2	1	1	3	1	2	3	2
CO4	3	2	2	2	2	1	3	2	1	1	3	2	2	3	2
CO5	3	3	3	3	2	1	2	2	1	2	3	3	3	2	2
CO6	3	3	2	2	3	1	3	3	2	3	3	2	2	3	3

Strong - 3 **Medium-2** **Low-1**

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(For the Candidates admitted in the academic year 2026-2027)
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY

Semester: II- **NME-1: Chemistry of pollution, Food and Cosmetics**

Ins. Hrs. /Week :2 **Course Credit: 2** **Course Code:** P26NMECH21

COURSE OBJECTIVES:

- Understand the sources, types, causes, effects, and control measures of air, water, soil, and noise pollution.
- Explain the impact of environmental pollutants on human health and the importance of pollution monitoring and prevention strategies.
- Acquire knowledge of food chemistry, including food constituents, additives, preservatives, antioxidants, adulterants, and quality standards of various food products.
- Understand the composition, formulation, evaluation, and quality control of cosmetic products, including raw materials, additives, colors, and perfumes.
- Develop awareness of environmental protection, food safety, and cosmetic standards to promote sustainable and healthy living.

UNIT – I AIR POLLUTION: (6 HOURS)

Air- Introduction- Definition- Composition of air- Air pollution-Definition-Air pollutants-Types of Air pollution - Causes of Air pollution on human health- Prevention of Air pollution

UNIT – II WATER POLLUTION: (6 HOURS)

Water-Introduction-Definition-Sources of water-Types of water-Water quality parameters-Water pollution- Definition-Types of Water pollution- Causes of Water pollution on human health-Prevention of Water pollution.

UNIT – III SOIL POLLUTION: (6 HOURS)

Soil quality standards, monitoring and analysis of selected soil contaminants: pesticides, heavy metals, POP's, fluoride, cyanide, nitrate, phosphate, oil & grease, Geobiochemical impact of municipal solid waste, steel plants effluent, domestic sewage.

UNIT – IV FOOD CHEMISTRY: (6 HOURS)

Introduction to general Constituents of food, Proximate Constituents and their analysis, Additives- Introduction -Types - Study of preservatives colors and Antioxidants and method of estimation, adulteration - Introduction, Types, Test for adulterants.

Introduction of standards composition and analysis of following foods: Wheat, Bread, Biscuits, Jam, Jelly, Honey, Milk, Ice Cream, Butter, Cheese, Milk Powder, Oils and Fats, Tea, Coffee, Soft drinks, Alcoholic beverages, Cereal and pulses, Confectionery, Fruits, Vegetables, Egg, Fish, Meat.

UNIT – V COSMETICS: (6 HOURS)

Introduction of Cosmetics, evaluation of cosmetics materials, raw material and additives, Cosmetics colors, Perfumes in cosmetics, Cosmetics formulating, introduction, standards and methods of analysis, Creams, Face powders, Make- up, Shaving preparations, Bath preparations.

UNIT – VI Current Contours (For Continuous Internal Assessment Only – Self Study)

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices.Noise control methods.

COURSE OUTCOME

1. Describe the composition of air and water, identify major pollutants, and explain their sources, effects, and preventive measures.
2. Analyze soil pollution caused by pesticides, heavy metals, industrial effluents, and municipal wastes and evaluate their environmental impacts.
3. Explain the chemistry of food constituents, additives, preservatives, antioxidants, and methods used for food quality assessment and adulteration detection.
4. Discuss the formulation, ingredients, standards, and analytical methods used in cosmetic products and personal care preparations.
5. Evaluate environmental and public health issues related to pollution, food safety, cosmetic quality, and noise pollution, and suggest appropriate control measures.

TEXT BOOK(S)

1. Miller, G. T. (2012). *Environmental science* (14th ed.). Cengage Learning.
2. Sharma, S. C. (2026). *Environmental chemistry*. J. K. International.
3. Goel, P. K. (2006). *Water pollution: Causes, effects and control*. New Age International.
4. De, A. K. (2006). *Environmental chemistry* (6th ed.). New Age International.
5. Kudesia, V. P. (1990). *Water pollution*. Pragati Prakashan.

REFERENCE(S)

1. Manahan, S. E. (2017). *Environmental chemistry* (10th ed.). Lewis Publishers.
2. Sharma, P. D., & Kaur, H. (2010). *Environmental chemistry*. Krishna Publishers.
3. De, A. K. (2006). *Environmental chemistry* (6th ed.). Wiley Eastern.
4. Khopkar, S. M. (2007). *Environmental chemistry: Analysis*. New Age International.
5. Welcher, F. J. (1975). *Standard methods of chemical analysis* (Vol. 3). Van Nostrand Reinhold.
6. Rose, J. (Ed.). (2004). *Environmental toxicology*. Gordon and Breach Science Publishers.
7. Baird, C. (2025). *Environmental chemistry*. W. H. Freeman.
   Get smart

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E-RESOURCES:

1. https://www.unwater.org
2. https://www.epa.gov/water-research
3. https://www.who.int
4. https://nptel.ac.in
5. https://www.worldbank.org/en/topic/waterresourcesmanagement

MAPPING WITH PROGRAM OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
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CO2	3	3	2	2	3	1	1	2	1	1	3	2	1	2	3
CO3	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO4	3	3	2	2	2	1	1	2	1	1	3	2	2	2	2
CO5	3	3	2	2	3	1	1	2	1	2	3	2	2	3	3
CO6	3	3	3	3	3	2	1	2	2	3	3	3	3	3	3

Strong - 3 **Medium-2** **Low-1**